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THE ELECTRIC LIGHTING ACT.

(*Continued from page* 106.)

As the "unit" proposed by Mr. Fletcher Moulton is now being discussed in our columns it seems probable that the subject will be there sufficiently ventilated without much comment from us; and it is, therefore, only necessary to say that the more we consider the "unit" the more convinced we feel that Mr. Moulton's proposition is really a very good and practical one. A letter dealing with this matter will be found in our Correspondence columns, from a writer signing himself "E.," and this will doubtless be read with interest. The next point in the "Provisional Order" demanding attention is that concerning the tests to be applied to the *mains* and *service lines*.

The Board of Trade may require these conductors to be tested previous to use, and whenever the undertakers have laid down lines they must give *four days'* notice to the Board before the same are used, and the Board of Trade shall have the right to require the undertakers to allow such mains to be tested for insulation and conductivity before they commence to use them for general supply. The cost of such testing shall be borne by the undertakers.

There is a provision made for periodical testing by the Board of Trade, and by whom it is to be performed. The following clauses deal with this point:—

The Board of Trade (if requested so to do by any local authority having jurisdiction within the area of supply, or by any consumer of electricity resident therein) may, as and when they shall think fit, *but not oftener than once in three months*, require the undertakers to allow their mains, or any portion thereof, to be tested for insulation and conductivity.

The testing referred to shall be performed by a competent and impartial person, appointed by the Board of Trade, as inspector of electric lines and works, and shall be done in such manner as he shall direct. The undertakers shall have the right to be present at such testing, but shall not interfere therewith, and in case the undertakers shall be found to be in default in one or more of the matters tested, they shall bear the costs of the said testing, or such part thereof as shall seem just to the Board of Trade.

In case the insulation or conductivity of the said mains or any portion of them is found by such testing as aforesaid to be *below* the standard fixed by the provisions of this Order, the Board of Trade may require the undertakers forthwith *to remedy such defect*, and the undertakers shall with all *reasonable* speed proceed so to do, but the Board of Trade *shall not be entitled* to require the undertakers not to commence or continue to supply by such mains or such portion of them by reason of such defect, unless the defect shall be *certified by the person performing the testing* to be of *sufficient magnitude and importance* to render it *necessary* so to do.

Nothing in this Order contained shall be deemed to give to the Board of Trade or any other person any right to have access to or interfere with the mains of the undertakers for the purpose of testing *otherwise than at the points at which the undertakers have reserved for themselves access* to their said mains.

Any consumer may, *when and so often as he shall desire*, require the undertakers to test the insulation and conductivity of the service lines which supply him, and he may require the local authority having jurisdiction within the area in which such service lines are situated, to nominate some competent and impartial person to assist at such testing. The undertakers and the local authority may respectively fix a reasonable sum as a charge for such testing in respect of the services of the undertakers and such other person, and the costs of such testing shall be borne *by the undertakers* or *by the consumer, according* as the undertakers are found to be in *default* or *otherwise*.

We were on the point of saying that it might safely be left to the undertakers to keep their lines up to the standard fixed, which will be found in our columns further on. Up to the present, however, such a lamentable want of experience has been shown by those responsible for the selection of underground wires for electric lighting purposes—so many cables having been laid and taken up again as unsuitable—that, although these provisions should really be unnecessary, Mr. Moulton probably felt himself justified in stipulating that the electrical condition of the cables should be occasionally examined by higher authorities than the undertakers themselves. We are, however, rather surprised that the engineers to some of the electric light companies did not object to anything further than the *first* test, which need not be called in question, and may be compared to the "passing" of a new line of railroad by an inspector appointed by the Board of Trade, which is then left to the company owning such a line to keep in repair and working order afterwards.

PROVISIONS AS TO TESTING *SUPPLY*.

Any local authority having jurisdiction over any portion of the area of supply may, *at such places as they think fit*, erect at their own cost such number of testing stations as they shall deem to be sufficient for testing the supply of the undertakers through the distributing mains used by them for the purposes of general supply within the jurisdiction of such local authority, and may place thereat proper and suitable instruments, of a pattern to be approved by the Board of Trade, for the purpose of testing such supply, and they *may require the undertakers to connect such stations by means of such service lines as the said local authority shall think fit, with any point of the mains of the undertakers* within such jurisdiction, at which the undertakers *shall have reserved for themselves access to such mains*. The *cost of such service lines* and the laying down of the same shall be borne by the local authority.

Such local authority may employ competent and impartial men to examine and record the readings of such instruments as aforesaid, at such times and in such manner as they shall see fit, and such readings shall be, in the absence of evidence to contradict the same, *primâ facie evidence of the truth of the matters they record*.

The undertakers shall have the right to have access at all reasonable times to such instruments for the sake of testing the same and ascertaining if the same are in order, and may require such local authority forthwith to have the same put in order in case they are not so.

The undertakers shall also set up and keep in due and proper working order, upon all premises from which they supply electricity to any distributing mains, suitable and proper instruments for measuring thereat the *difference of potential* between the positive and negative mains (or the mains and the earth, as the case may be) and the *current*, and shall record and keep recorded the readings of these instruments, taken at intervals of not more than *one hour* during the time that electricity is being supplied thereto from such premises. The readings of such instruments shall be *primâ facie evidence, in the absence of evidence to contradict them*, of the matters that they record.

Any local authority having jurisdiction in any portion of the area supplied by any such distributing mains shall have the right to have access at all reasonable hours to the instruments mentioned in the last preceding section, by a competent and impartial person employed by them in that behalf, for the purpose of testing the same and ascertaining if the same are in order, and in case the same are not so, they may require the undertakers forthwith to have the same put in order. The undertakers shall have the right to be present at such inspection, but shall not interfere with the same.

It will be seen from the above that local authorities may erect testing places and keep instruments, that the undertakers may test the instruments of the local authorities, and that the latter may do likewise with the apparatus of the undertakers.

The penalties liable in case of default in supply need not be dwelt upon at length. These will be much the same as are in force for gas—penalty for neglect to supply private consumers, penalty for neglect to supply for public lighting, penalty for insufficient pressure, &c.; but the undertakers

shall not be deemed to have committed default in respect of their supply, unless such default shall from the frequency of its recurrence on the same night or during the same day, or from its *magnitude or duration*, be of a *substantial* character.

In case the undertakers shall become liable to any penalties for default in supply under the preceding sections, the Board of Trade may, if it *shall think fit, relieve them from the same*, either unconditionally or upon such terms as they shall think fit.

REGULATIONS AS TO SAFETY, &c.

The following regulations shall be observed by the undertakers in respect of *mains* and *service lines:*

(*a*) The current through any distributing main or service line shall not exceed *two thousand ampères* per *square inch of section* of a *pure copper wire* of *equal conductivity*.

(*b*) The insulation per mile run of all distributing mains, or service lines, shall be not less than *five thousand ohms* for *every volt* in the corresponding *standard pressure*.

(*c*) All distributing mains and service lines, so far as they lie in or under streets and public places (otherwise than in distributing boxes or stations), shall be covered with thoroughly *waterproof covering* and be contained in pipes or cases of sufficient strength to protect them from injury.

(*d*) The supply of electricity to each house shall be capable of *being turned off at some point outside the building*.

(*e*) In *each conductor of each service line* shall be inserted a *safety fuse* or other safety connection of a pattern to be approved by the Board of Trade. Such fuse or connection shall be situated in a distributing box, or at some other point in the service line which is easily accessible, and shall be of such a nature as to cut off the supply when the current through such conductor *exceeds by more than one hundred per cent.* (or such other smaller proportion as the undertakers may think fit) the maximum current which such service line is intended to supply.

(*f*) The positive and negative poles within the premises of the consumer shall be at a distance of *not less than three inches*, and the terminals shall be of a construction and pattern to be approved of by the Board of Trade.

(*g*) *In case the undertakers employ earth returns* in connection with any distributing mains they shall provide, at a distance of not less than *three* inches from the pole supplied therefrom in any house or building, an earth pole, which shall be in good electric contact with the earth, and it shall be incumbent upon the undertakers to maintain such earth pole in good and efficient working order, as though it were a pole in connection with one of the mains of their system.

(*h*) The difference of potential at corresponding points of the positive and negative conductors of any distributing main or service line shall not at any time *exceed four hundred volts*, and no portion of any such main shall be at a potential differing from that of the earth by more than such quantity.

(*i*) The difference of potential at corresponding points of the positive and negative conductors of any *charging main*, or *other main which is not in metallic connection with the poles* in any consumer's house, shall not exceed *four thousand* volts, and no portion of any such main shall be at a potential differing from that of the earth by more than such quantity.

Provided always that nothing in these regulations shall prevent the supply by the undertakers, *by agreement*, of *arc lighting* on the *series system*, either for public or private lighting, *by means of currents of any tension*, subject (in case they do not comply with the above regulations) to such *regulations as the Board of Trade shall from time to time make in that behalf*.

The following regulations shall be observed by the consumers in respect of all electric lines *within houses or buildings:*

(*a*) The conductors between the poles to which the supply is given, and the apparatus for utilising such supply, shall be of such a size and nature that the current passing through them shall not at the time when it is at its greatest exceed *two thousand ampères* per square inch of section of a pure copper wire of equal conductivity.

(*b*) No portion of such conductor shall *be naked and unprotected*, so as to be liable to be touched. Any conductor in metallic connection with such conductor shall be taken *to be part thereof* for this purpose.

(*c*) All parts of conductors *laid along or within a distance of six inches* from the walls, ceilings, floors, or other portions of the fabric of the building shall be insulated, with a covering giving a minimum insulation of *five thousand ohms* per volt in the standard pressure at the junction of the mains and the service lines by which the building is supplied. Such covering shall be *waterproof*, and to have an *external fire-proof coating or covering*, either of cement, paint, or prepared textile substance, or otherwise, or be of a nature and construction approved of by the Board of Trade.

(*d*) The apparatus *utilising the supply* or the parts thereof which the current passes shall be *insulated* from the walls, ceilings, floors, and other portions of the fabric of the building.

(*e*) Save in or in the immediate neighbourhood of the apparatus for utilising such supply, the conductors carrying the same shall not be nearer to each other at any point of their course than *one inch*.

(*f*) No consumer shall permit the circuit in his house to have *less resistance* than such as will suffice to give him a current *of the maximum amount* fixed by him under the provisions of the section relating thereto, when the difference of potential in the distributing mains is at its standard amount.

(*g*) In case earth returns *are not used* by the undertakers, *no portion of the circuit shall at any time be put to earth*.

(*h*) *If earth returns are used* by the undertakers, no portion of the circuit shall be put to earth *otherwise than by being connected with an earth pole* provided by the undertakers under the provisions of the last preceding section. The conductors leading to such earth poles shall be deemed to be conductors within the meaning of this section, and shall comply with the conditions herein contained relative to such conductors.

In these regulations for safety, &c., there are many points to review, and we shall therefore reserve our remarks till next week. In the meantime we should be pleased to be favoured with the opinions of any of our readers on any portions of the subject. We would draw attention to the size of the conductor for a current of 2,000 ampères. Is an insulated wire of one square inch in section sufficiently large to bear this current? The insulating covering to the conductors also demands serious consideration.

The insulation proposed by Mr. Moulton, as a minimum, is, luckily, likely to be exceeded by many times whenever gutta-percha or india-rubber is employed, and instead of having an insulation of 2 megohms per mile (for 400 volts) we are nearly sure to get something like 250 megohms as a minimum. We do not say that 2 megohms would not be sufficient, provided the insulating properties of the material employed for covering the wire were good *throughout*, but such a low insulation resistance per mile for any material at present in use would indicate a local fault, which, sooner or later, would develop itself into larger proportions.

(*To be continued.*)

EXPERIMENTS ON THE TRANSMISSION OF POWER TO A DISTANCE.

WE now give all that our representative was allowed to see in the curious experiment of the 6th inst., at the workshops of the Chemin de fer du Nord, made by M. Marcel Deprez, where science only played a very secondary part, and upon which, in our last number, we made some remarks which we shall justify.

We will notice first the *ensemble* and then examine the details. The system consists of a Gramme machine modified by M. Marcel Deprez as generator, and a second Gramme machine, type C, as receiver, and of a line formed partly of a thick copper wire, three or four metres long, perfectly insulated, and on the other hand of a telegraph wire supported upon poles and formed of an iron wire of four millimetres diameter and 20 kilometres long (out and return). The two machines were placed side by side at the forges of the Chemin de fer du Nord, at La Chapelle. The generator was actuated by the general power supplying the workshop; there was placed upon an intermediate shaft, between the shaft from the source of power and the pulley of the generator, a *transmission dynamometer* lent by the Conservatoire des Arts et Métiers, but on the day of the experiments this dynamometer, destined to measure the work absorbed by the generator, *would not act*, and was therefore not used.

The pulley of the Gramme receiver, type D, was provided with a "Prony" brake, destined to measure the work produced. The work furnished, according to the engineers and employés of M. Marcel Deprez, who made the experiments and the calculations and then announced them to the public, varied between *two* and *three* H.P., whilst the work expended, and consequently the mechanical return could not be ascertained.

The only figures which we possess so far on these experiments were furnished by M. Marcel Deprez and published in the last number of *La Lumière Electrique*. We give them below:

Resistance of the telegraph wire...	...	160 ohms.

Generator.

Resistance of the inductors	20 ohms.
,, ,, bobbins... ...	36 ohms.
Number of revolutions per minute	650
Intensity of the current	2·1 ampères.

Receiver.

Resistance of the inductors	50 ohms.
,, ,, bobbins... ...	33 ohms.
Number of revolutions per minute ...	313
Resistance of the total circuit	299 ohms.
Useful work measured on the brake per second	156 kilogrammetres.

There is only missing from the figures given by M. Deprez the measurements of the electromotive force and those of the mechanical work expended. By a series of hypotheses and arguments, M. Cornelius Herz, the signatory of the article in our contemporary to which we have alluded, estimated the total mechanical work supplied to the generator, and gives it equal to 418 kilogrammetres per second, which induces him to consider 37 per cent. as the lowest limit of the industrial mechanical return.

We record these results without comment, because the experiments must soon be repeated under more favourable conditions, and very accurate measurements will be undertaken in a few days. We shall hope to return to them at a suitable time.

We now come to the arrangement of the machines. They are characterised by the fact that the wire coiled upon the inductors and bobbins is very fine, in order to obtain high tension and to work with as little intensity of current as possible, since, for a given resistance, the loss due to the heating of the circuit is proportional to the square of the intensity.

The generator, identical in principle with the Gramme machine, differs from it in two points: the *form* of the inductors and the *construction* of the collector or commutator. The receiver is a Gramme machine, C type, coiled with fine wire.

The inductor, or more correctly, the inductors, consist of two electro-magnets of large dimensions, placed opposite each other, with their poles of contrary names opposite, and provided at their extremities with pole-pieces curved in a semicircle; the four poles of the two electro-magnets leave thus between them two cylindrical spaces, in each of which turns a Gramme ring. The bobbins of the electro-magnets and the rings of the two machines, are connected in series in such a way that the inductors are excited by the total current.

The inductors are coiled in several sectional bobbins; the ends of the wire from each of these bobbins are attached to terminals fixed upon a board, so that one can vary at will the number and coupling of the acting bobbins, which is an excellent arrangement in an experimental machine such as that which we are describing.

M. Marcel Deprez attributes to inductors of this form a great superiority over the inductors with consequent poles of the ordinary Gramme machine. In his opinion, the lines of force produced in the field by the passage of the current in the bobbins, not being deflected to the polar extremities, are at once more regular, better distributed, and furnish, all other elements being the same, a magnetic field less costly to produce.

This is a matter upon which accurate experiments could best assure us, therefore we content ourselves with mentioning this opinion without speaking for or against its truth.

This disposition of the inductors is not new, for we have already an application of it in every alternating current machine—Lontin, Gramme, Wilde, Gordon, &c., and in a good number of continuous current machines, among which we mention those of Brush, Andrews, Jürgensen, Arago (disc), Wallace-Farmer, &c.

The collector of the machines employed by M. Marcel Deprez is characterised by the nature of the insulating material separating the segments of the collector (80 in number); this insulator is air; the extremities of each segment are riveted into two discs of ebonite, placed at each end of the collector, and separated along their length by air which insures a good insulation here rendered necessary by reason of the high tension of the currents employed.

We shall have said all that is needful at present about these experiments when we once more call attention to the special arrangement of the circuit which connects the two machines.

By referring to the diagram which appeared in our last number, it will be seen that the leakage of the line has no effect on the relation of the intensity of current which traverses each of the machines; this intensity will be always the same in both, owing to the arrangement adopted; the electrical return is thus improved, and only depends on the relation of the electromotive forces developed by the two machines, but it must not be ignored that it is altogether otherwise in practice, and we should be exposed to great errors by reckoning the actual return, on a real line, according to the results given by this special arrangement upon which leakage is an advantage instead of a loss, as in the ordinary case of transmission of power to a distance.

The losses by derivation upon aerial lines, as shown by the potential at its various points, are still little known; we might almost add that they are not known at all.

We read in *Electricity and Magnetism*, by Fleeming-Jenkin, fourth edition, page 317: "Surface conduction, which is the chief cause of leakage on land lines, allows *much more* than double the current to pass when the E. M. F. is doubled." This is a valuable but purely qualitative indication; it shows that the use of high tension considerably increases the influence of leakage, which thus becomes no longer ignorable, even upon a line only twenty kilometres long. We have, therefore, the right to ask, even to insist, that in experiments on the transmission of power to a great distance by high tension currents, the machines be disposed under such conditions that the influence of the leakage figures in the measurement, with its true magnitude and the actual influence which it exerts. It is for this reason that the experiments undertaken at the Chemin de fer du Nord give no information whatever upon electrical transmission of power by aerial telegraph wires as long as the coupling of the machines remain as described. Moreover, we only accept the results announced or promised with the most extreme caution, a caution dictated, among other reasons, by the quite special and particularly favourable conditions of the installation. If, instead of joining the two terminals of the machine together in the workshop with a length of copper wire, M. Marcel Deprez would connect these two terminals to *earth*, the results would be entirely different. Any leakage on the telegraph wire would *reduce* the percentage of power reproduced in the receiver, and only under this condition, or by placing the generator at one end of the line and the receiver at the other, can M. Deprez's tests be deemed worthy of consideration.

ON THE ELECTRICAL RESISTANCE OF CARBON CONTACTS.

A VALUABLE paper by Mr. Shelford Bidwell, bearing the above title, was recently brought before the Royal Society. The object of Mr. Bidwell's researches was to investigate more systematically than had been done before the well-known fact that the electrical resistance of carbon contacts diminishes with increased pressure. The experiments were really undertaken with the object of establishing a quantitative relation between pressure and resistance. As Mr. Bidwell remarks, loose contacts are proverbial for the uncertainty of their action, but by multiplying the experiments the element of uncertainty was removed to such an extent that it was possible to indicate a general law with tolerable accuracy.

The apparatus used for regulating the pressure is shown in fig. 1. It consists of a little balance. H K is a light steel rod formed of a fine knitting needle balanced at C on a knife edge, which is fixed at right angles to it. To one end, K, is attached a split tube of thin copper for holding short rods of the different materials to be tested, which are held so as to press at right angles upon another rod, R, supported in a spring clamp.

Midway between C and K is hung the scale-pan, S, and at H is a sliding counterpoise, which, at the beginning of an experiment, is so adjusted that a weight of ·01 grm. in the scale-pan will just bring K and R into contact with one another. Electrical connection is made through the wires, W_1 and W_2, the former of which is attached to the clamp holding R, and the latter communicates with a mercury cup,

into which dips a wire attached to the rod, H K, at the point, C. It is evident that the pressure between K and R will be equal to half the weight in the scale-pan, S.

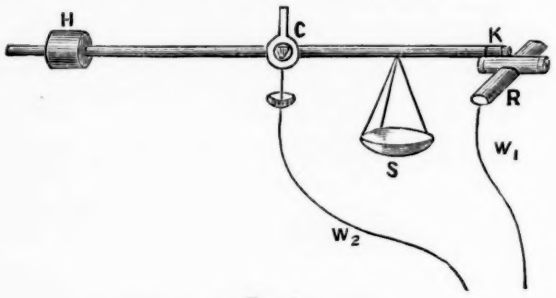


FIG. 1.

In order to show the relation between the pressure of carbon contacts and their resistance, two short rods of electric light carbon, 6 mm. in diam., were placed in the instrument, as shown at K and R, and the resistance at different pressures measured with a Wheatstone's bridge. The means of three series of measurements will be found in table 1.

TABLE 1.

Pressure. Grammes.	Resistance. Ohms.	Pressure. Grammes.	Resistance. Ohms.
·25	16·10	5·	4·23
·5	11·00	7·5	3·53
1·	8·43	10·	3·06
1·5	6·70	12·5	2·80
2·	6·15	15·	2·60
2·5	5·90	17·5	2·46
3·	5·13	20·	2·33
3·5	5·00	25·	2·16
4·	4·60	50·	1·86
4·5	4·33		

A curve constructed from these figures shows clearly that the greatest variations occur when the pressure is small and the resistance comparatively high. In making these measurements Mr. Bidwell varied the disposition of the proportional coils, and used different numbers of battery cells.

It soon became evident that the resistance of the carbon contact was largely dependent on the strength of the current used, as will be observed in table 2.

TABLE 2.

Pressure. Grammes.	Resistance in ohms with			
	1 cell.	2 cells.	3 cells.	4 cells.
·25	11·10	7·20	4·70	3·55
·5	5·95	4·70	4·10	3·50
1·	4·40	3·65	3·25	3·10
1·5	3·60	3·20	2·95	2·80
2·	3·55	3·15	2·80	2·50
2·5	3·35	2·95	2·65	2·40
3·	2·90	2·55	2·35	2·30
3·5	2·45	2·30	2·05	1·95
4·	2·25	2·10	2·00	1·90
4·5	2·10	1·95	1·85	1·75
5·	1·95	1·85	1·75	1·70
7·5	1·55	1·55	1·50	1·45
10·	1·50	1·45	1·40	1·35
25·	1·15	1·05	1·05	1·05

The measuring current was further varied by inserting a resistance-box *between the battery* (two Leclanché cells) *and the bridge arrangement*. Table 3 gives a few of the measurements and shows that the resistance of the carbon contacts varies greatly with the strength of the current when the pressure is small and but very slightly when the pressure is great.

TABLE 3.

Added resistance in circuit. Ohms.	Resistance in ohms with pressure of			
	·5 grms.	2·5 grms.	7·5 grms.	25 grms.
0	5·6	2·7	1·7	1·02
5	—	2·8	1·8	1·03
10	6·9	2·9	1·8	1·03
50	7·7	3·1	1·9	1·03
100	8·6	3·1	1·9	1·03
500	9·3	3·1	1·9	1·03
1,000	9·7	3·1	1·9	1·03

Thus far Mr. Bidwell's experiments show clearly that the diminution of resistance which occurs when the pressure between carbon contacts is increased is not, under ordinary circumstances, due solely to increase of pressure, but that the total decrease in resistance is due partly to increase of pressure and partly to *increase* of *current strength*.

In further experiments special means were taken to maintain *constant currents* of ·1 and ·001 ampère respectively, but with a varying contact pressure of from ·05 to 25 grms. We need not tabulate the figures obtained, but will merely state that the results showed that with small pressures the resistance is largely dependent upon the strength of the current, but when the pressure is considerable the resistance with weak and strong currents is nearly the same. The same effect may be exhibited in another form by varying the *current* and keeping the *pressure* constant.

In order to ascertain whether the decrease of resistance under pressure was entirely of a temporary nature, Mr. Bidwell devised a special arrangement of apparatus and in every instance the resistance was found to return almost exactly to its original value upon the removal of the extra pressure employed. This same test repeated with a resistance of 300 ohms between the battery and the bridge showed that the final resistance was almost invariably slightly higher than the original resistance; but this increased resistance gradually diminished and would probably in time return to its original value.

Under certain circumstances, however, Mr. Bidwell finds that the current produces a permanent and not merely temporary effect upon the resistance; that is to say, the resistance of the contacts (so long as they are undisturbed by vibration or otherwise) is found to be lower or higher after the current has ceased than it was at first.

Thus, for example, with a pressure of ·5 grm. at the point of contact, the resistance measured with a current of one or two milliampères was found to be 10·5 ohms. A current of ·15 ampère was then passed through the carbons for 10 seconds; and on again testing with the weak current the resistance was found to have fallen to 5·8 ohms. With a pressure of 2·5 grms. the same current reduced the resistance from 6·6 to 4·3 ohms. With 5 grms. the resistance was permanently reduced from 4·7 to 3·4 ohms; and with 25 grms., from 2·4 to 2·0 ohms. All these effects were produced by a current of ·15 ampère. Stronger currents (up to a certain point) effect greater reductions.

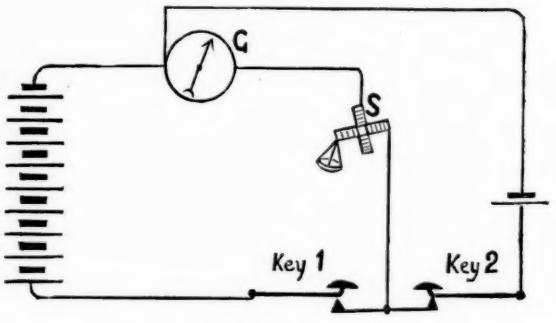


FIG. 2.

But when the proportion of the current strength to the pressure exceeds a certain limit, the effect of the current is apparently to produce a permanent *increase* in the resistance, and this increase is generally very considerable. The carbon contacts, a tangent galvanometer, a box of resistance coils, and a battery of 10 Leclanché cells are connected in simple circuit, and the strength of the current gradually increased by plugging out resistance in the box. As the current increases the deflection of the galvanometer needle becomes greater until a certain strength is attained, when the galvanometer needle suddenly goes back and comes to rest almost or exactly at zero. The lighter the pressure the smaller the current necessary to produce this effect.

In attempting to measure the high resistance with a Wheatstone's bridge and a small current, the curious fact was brought to light that the resistance in question is generally very much lower for weak than for strong currents.

Thus it may happen that while the moment before measurement the resistance may be sensibly infinite, the very act of measurement reduces it to a few hundred ohms.

This paradoxical effect is shown by the special arrangement indicated in fig. 2. G is a tangent galvanometer, S the carbon balance, in the scale-pan of which is a weight of 1 grm. When the key, 1, is depressed, the current from 8 Leclanché cells passes through the galvanometer and the carbons. The immediate effect was a deflection (in Mr. Bidwell's particular form of galvanometer) of about 75°. Almost instantly, however, the needle returned to zero, and key 1 might then be raised and depressed without producing the slightest movement of the needle. If, however, key 2 is depressed, the current from a single cell will pass through the galvanometer and the carbons, and this will generally produce a small deflection of from 2° to 10°. But if key 1 is once more depressed, the needle again altogether fails to move. The resistance at S is, therefore, of a very peculiar nature, being more easily overcome by a small electromotive force than by a high one. Though the experiment as thus described is generally successful, it occasionally happens that the single cell fails equally with the larger battery to overcome the resistance.

For a systematic investigation of the last-mentioned group of phenomena the apparatus was arranged as shown in fig. 3.

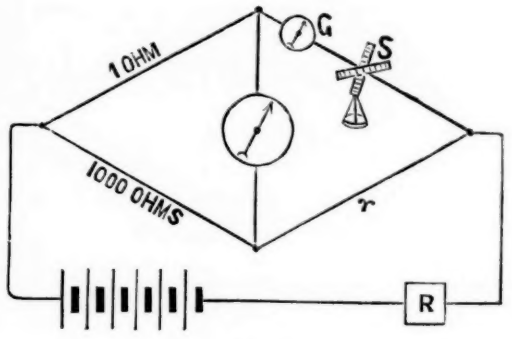


FIG. 3.

It is essentially a Wheatstone's bridge arrangement, the proportional coils used being 1 and 1,000 ohms. A tangent galvanometer of ·9 ohm resistance is inserted in the same arm as the carbon balance, and a box of resistance coils, R, is placed between the battery (which consists of eight or ten Leclanché cells) and the bridge. The arrangement admits of the measurement of the resistance of the carbon when traversed by strong currents, the strength of which can be regulated by the resistance-box, R, and measured by the tangent galvanometer, G. A given weight being in the scale-pan, known currents of gradually increasing strength were passed through the carbon. The resistance was measured: first, while the known current was passing; second, with a very small current obtained by unplugging 10,000 ohms in the resistance-box. As the currents increased in strength, the resistance measured with the very small current gradually diminished until a point was reached —and the lighter the weight the sooner this was the case— at which the resistance suddenly became infinite.

Experiments were made with metallic contacts for the sake of comparison, but metallic loose contacts were found more uncertain in their action than those of carbon. Under the same conditions as nearly as could be reproduced the results were often very different. The metal chiefly used was bismuth for its high specific resistance, but some experiments were made on copper and platinum. The first unexpected phenomenon which attracted notice in working with bismuth was the great *permanent fall* in the resistance, which was produced by an ordinary current with light pressures. With a single Leclanché cell, the lightest contact— the pressure being certainly less than ·01 grm.—failed to give a higher resistance than 9 ohms; but with 400 ohms inserted between the battery and bridge a pressure of ·35 grm. gave a resistance which on different occasions varied between 73 and 110 ohms. When once, however, the resistance has been reduced by a strong current, the changes which occur when a feebler current is used are comparatively small—unless, of course, the points of contact are first separated. After the passage of the current which has caused the resistance to diminish so remarkably, the bismuth cylinders are found to adhere to each other so closely that quite an appreciable force is necessary to part them. This effect, which is common to all metals, has been thoroughly investigated by Mr. Stroh (see *Journal of Society of Telegraph Engineers*, vol. xix.).

Another apparent anomaly is this: a *small* weight being in the scale-pan and a weak current sent through the points of contact, the resistance comes out high; on passing a strong current, the resistance is greatly diminished. If now the current be reduced to its original strength the resistance will not rise to its original value; it will not, in fact, rise at all, but will be still further diminished. It is necessary, however, in these experiments that the surfaces in contact should be absolutely clean. Unless they are scraped before the measurements are made the opposite effect may result— that is (after the first great fall in resistance), diminished current may produce increased resistance.

When the bismuth surfaces are clean, contact takes place entirely through the metal. The current heats the metal at the contact points to a degree dependent upon the current strength, and the resistance increases with the temperature. Strong currents will, therefore, give a higher resistance than weak ones.

When the surfaces are not clean a film of oxide or some foreign substance is interposed, and then, as with carbon, a weak current shows the higher resistance. The diminution of resistance effected by pressure is generally of a permanent nature, continuing to a great extent after the pressure has been removed (so long as the contact points are undisturbed), thus reversing the case of carbon.

Mr. Bidwell summarises his investigations as follows:—

I. Carbon Contacts.

Changes of *pressure* produce proportionately greater changes of resistance when the initial pressure is *small* than when it is great.

Changes of *pressure* produce proportionately greater changes of resistance with *weak* currents than with strong ones.

Changes of *current* produce proportionately greater changes of resistance with *small* currents than with large currents; and with *light* pressures than with heavy ones.

When the resistance of a carbon contact has been *reduced* by an increase of *pressure*, it will, on the removal of the added pressure, *rise* to approximately its *original* value. The passage of a current whose strength does not exceed a certain limit depending upon the pressure, causes a permanent diminution in the resistance, and the stronger the current the greater will be such diminution. When the strength of a current exceeds a certain limit, the resistance is greatly and permanently increased. The greater the pressure the higher will be such limit.

Unless special means are adopted for preserving a constant current, the fall in the resistance which attends increased pressure is greater than that which is due to increased pressure alone, being partly due also to increased strength of current.

It is not proved that the diminished resistance which follows an increase of current is an effect of temperature.

2.—Metallic Contacts.

In the case of bismuth and probably of other metals, with a given pressure the weaker the current the higher will be the resistance. This effect is most marked when the pressure is small.

Increase in the strength of the current is accompanied by a fall in the resistance, and if the current be again reduced to its original strength, the resulting change in the resistance will be small, and it will in no case return to its original value. Diminution in the strength of the current is followed by a small fall in the resistance if the metal is clean, and by a small rise in the resistance if the metal is not clean.

Increased pressure produces a greater fall in the resistance with small pressures than with great pressures, and with weak currents than with strong currents.

The resistance, after having been reduced by increased pressure, does not return to its original value when the added pressure is removed.

Reasons for the Superiority of Carbon over Metal in the Microphone.

The above observations may, perhaps, throw some light on a matter which has never hitherto been fully explained. Why does carbon give far better results than any metal when used in the microphone? It seems to me that this question may be answered without much difficulty. The mere fact that a current causes delicately-adjusted metal contacts to adhere to each other is sufficient to account for the superior efficiency of carbon. A metal microphone might, indeed, be used to transmit the pitch of a sound, provided that its vibrations were sufficiently powerful to cause actual separation of the points of contact. The fundamental tone might, in this way, be conveyed, but it is clear that the minute superimposed vibrations, due to the upper partials, upon which depends the distinctive character of a particular sound, would be very imperfectly represented, if not entirely lost. In addition to this phenomenon of adhesion, and probably connected with it, are the facts that metallic contacts, unlike those of carbon, do not even approximately recover their original resistance when once it has been reduced by increased pressure or increased current, unless indeed, complete separation occurs; and even the initial effect of pressure upon resistance is (except with very weak currents), in general, much more marked with carbon than with metals.

Lastly, it is to be noticed that in the case of carbon, pressure and current act in consonance with each other; pressure diminishes the resistance, and in so doing increases the strength of the current; and the current thus strengthened effects a further diminution in the resistance. In the case of metals, on the other hand (or at least in the case of clean bismuth), pressure and current tend to produce opposite effects. The resistance is diminished by pressure and the current consequently strengthened, but by reason of the increased strength of current, the resistance is higher than it would have been if the current had remained unchanged. The effect of this antagonism is not very great, but it seems to give a material advantage to carbon.

ON THE MOLECULAR RIGIDITY OF TEMPERED STEEL.

PROFESSOR D. E. HUGHES lately brought before the Institution of Mechanical Engineers his researches on the molecular differences between the constitution of iron and of steel. It has been suggested on many occasions that tempered steel is a true alloy of iron and carbon, and the learned professor has, in a late discussion on this subject, expressed his opinion in favour of the alloy. The experiments to which we now refer, however, were undertaken to investigate the peculiar molecular structure of tempered steel as indicated by the induction balance.

The particular form of instrument employed by Prof. Hughes, and made by Mr. Groves, of Bolsover Street, W., is shown by the figure.

A coil, having a large aperture, is fixed to a board; two small abutments or supports, at a few inches distance on each side of the coil, allow us to suspend or fix an iron wire passing through the aperture, which then becomes the core of an electro-magnet. This forms the essential portion of the apparatus. The iron or copper wire rests upon the two supports, which are 20 centims. apart; at one of these it is firmly clamped by two binding screws, while the opposite end can turn freely. The wire is 22 centims. long, projecting 2 centims. beyond its support. On the projecting end is a key or arm, which serves as a pointer moving on a graduated circle, and gives the degree of torsion which the wire may receive. A binding screw allows us to fasten the wire, after turning the pointer to any degree of torsion, and thus preserves the required stress as long as is necessary.

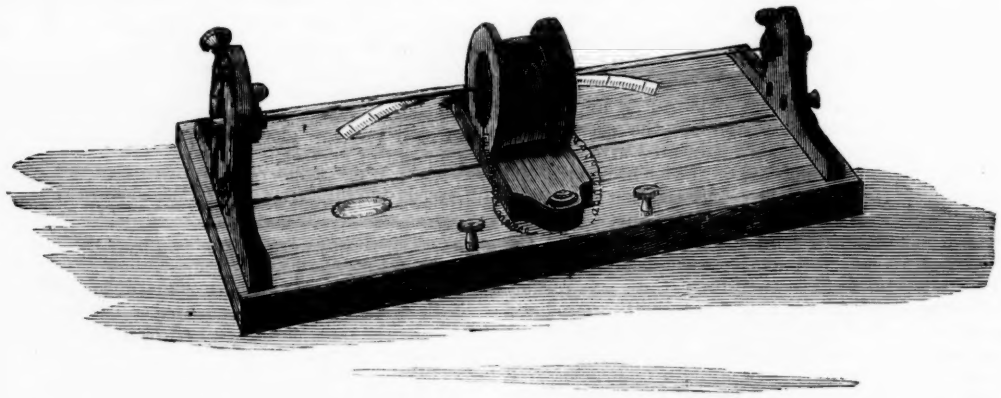
The exterior diameter of the coil is 5½ centims. and that of the interior vacant aperture 3½ centims.: the width is 2 centims. Upon this coil is wound 200 metres of No. 32 silk-covered copper wire. This coil is fastened to a small board, so arranged that it can be turned through any desired angle in relation to the iron wire which passes through its centre; and it can also be moved so as to lie over any portion of the 20 centims. length of wire, in order that different portions of the same wire may be tested under a similar stress.

The whole of this instrument, as far as possible, should be constructed of wood, in order to avoid all disturbing inductive influences of the coil upon other pieces of metal.

The iron wire at its rear or fixed end is joined to or makes contact with a copper wire, which returns to the front part of the dial under the board and parallel to the coil, thus forming a loop. The free end of the iron wire is joined to one pole of the battery; the copper wire under the board is joined to a rheotome, and thence to the other pole of the battery.

The coil is joined to a telephone or a sensitive galvanometer, and we may either pass the current in the manner described, or may reverse all the communications, passing the current through the coil instead of the wire, and listening with the telephone to the induced currents upon the iron wire alone.

When a copper wire is placed in the axis of the coil, with the above apparatus, and a current is passed through this wire, no trace of induced currents is found, simply for the reason that this copper wire crosses all of the wires of the coil at an angle of 90°. No effect takes place upon torsion being applied to the copper wire. If a small rod of iron be placed parallel with the conducting copper wire there is no effect; but if the iron rod is turned at an angle to the wires, a current is observed, the force increasing from parallelism to an angle of 45°, and decreasing again from this angle to 90°, where there is again no effect. The conducting copper wire thus induces magnetism in the iron rod, and this magnetism reacts upon the coil; but this only holds good under certain conditions.



If the copper wire spoken of is replaced by an iron wire, and intermittent currents sent through it, there is no induced current upon the coils; but the instant a very slight torsion is applied, say 10 or 20 per cent. of one turn, strong

induced currents are perceived. These are positive for right-hand torsion and negative for left-hand torsion. Thus not only can induced currents be produced, but, without changing the direction of the primary electric current, one can change the induced currents, making them positive or negative at pleasure, exactly as would occur if we rotated in opposite directions the small iron bars placed side by side with the copper wire.

At this point it becomes important to know if these effects are produced by the twists given by torsion to the whole mass of the wire, or if each molecule turns separately and independently round its axis, and there are many proofs that the latter view is correct.

As the object of the author was to show the remarkable difference which exists between iron and steel in this respect, he confines himself to showing the very great apparent rigidity of the molecules of tempered steel as compared with those of iron, and proceeds as follows:

"A very remarkable difference appears when we turn to tempered steel. For here we find that at certain degrees of temper (*e.g.* that known as blue or spring temper) there are only slight traces of molecular disturbance or rotation, no matter how many mechanical turns or twists we may put on the wire. In fact, the molecules here seem fixed and homogeneous throughout the mass. We have perfect molar elasticity, but no traces of rotation of one part over another—in other words, no molecular elasticity. Thus in iron we have an elasticity due solely to the freedom of molecular motion. In hard steel, on the contrary, we have but slight molecular freedom, with great molar elasticity, in which the separate molecules do not rotate separately, but all as one mass. A similar difference is shown also by several known alloys of iron.

"If we pass a constant and powerful current through a steel wire which previously gave feeble traces of rotation, and then heat this wire to red heat, a strong induced current is gradually produced. The current here has the power of rotating polarised and heated molecules, and so giving out comparatively strong induced currents. But on cooling this wire it is impossible again to reduce it to silence. The molecules remain rigid, but at an angle to the axis. With iron, however, upon the application of heat under the same circumstances, we have a most violent rotation, which entirely disappears on cooling—proving again the great comparative freedom of its molecules.

"We might believe that all the above effects in steel are due, not to the rotation of the molecules, but to the more or less retentive or 'coercitive' force of steel with regard to permanent magnetism. But coercitive force, whilst it may suffice to explain, according to accepted views, the retention of magnetism, does not explain why we can produce positive and negative currents by right or left handed torsions, nor why we should have induced currents by torsion. If we accept the term coercitive force as simply applicable to each molecule, then we have still to consider the greater freedom of motion of these molecules in iron than in steel. It is a general belief (which the author has hitherto shared) that the molecules of tempered steel have far greater coercitive force than those of iron. Contrary to the author's previous convictions, however, it appears, from a simple experiment made, that *iron possesses more coercitive force than steel whenever the inducing force is limited, and within the range of iron.*

"If iron merely possessed greater coercitive force than steel, it would be impossible for us to employ soft iron in electro-magnets requiring quick changes of magnetism.

"Assuming the freedom of motion of the molecules to be greater in iron than steel, it occurred to the author that he should be able to free the soft iron from its remaining magnetism by simple vibration of the wire. This was found to be the case. An iron and steel wire are magnetised to saturation, or both may be given the same amount of permanent magnetism. We will suppose that they both deflect the suspended needle through 40°. Now taking the steel wire and fastening one end in a brass vice, give its free end a slight pull to set it in vibration: it will be found that the steel has lost but 2°, having still 38° of permanent magnetism, which cannot be further reduced by repeated vibrations. The instant, however, that a similar vibration is given to the soft iron wire, its remaining magnetism nearly all disappears. There is left at most 2°, or in some cases only a trace. Thus the molecules are seen to be so comparatively free in iron that mere vibration will aid them in rotating. These two wires were again observed vibrating whilst under the influence of the permanent magnet. There was then a greater magnetic effect produced in the iron wire than previously, the vibrations aiding the rotations produced by the natural magnet."

The author was desirous to render visible this freedom of iron and rigidity of steel, so that these effects might be actually seen. For this purpose three glass tubes, or ordinary phials, are taken, of any length or diameter, say 10 centimetres in length by 2 centimetres in diameter. If we now put iron filings in these tubes, leaving about one-third vacant, so as to allow complete freedom in the filings when shaken, we find that each tube, when magnetised, retains an equal amount of residual magnetism, and that this all disappears upon slightly shaking the tube. We are thus imitating the effects of vibration. But if in one of these tubes we pour melted resin (or, in fact, any slightly viscous liquid, such as petroleum, suffices) we then render these filings more rigid, and then we can no longer produce by shaking the disappearance of its residual magnetism. In pouring in petroleum we have apparently been introducing a strong coercitive force; but we know that it can only have the mechanical effect of rendering the iron filings less free to turn, and so comparatively rigid. If we desire to see the effect of torsion, we have only to shake the filings, so that when the tube is held horizontal the vacant space is above, and rotate slightly (but without shaking) the tube containing the free filings about a horizontal axis. Its remaining magnetism instantly disappears upon rotation, although we have evidently not changed the longitudinal position of its particles. A similar effect takes place upon a soft iron wire, for if we magnetise it and observe its remaining magnetism, we find that upon giving a slight torsion to its wire, its remaining magnetism instantly disappears—a similar effect to that in the rotating tube of iron filings.

The author has remarked in these researches that in all alloys of iron the molecules are far more rigid than in the pure metal; and further that, with steel, tempering adds greatly to this rigidity. He is now engaged upon the question of the effect of different tempers on the same steel.

Soft steel, when compared with hard-drawn iron, shows that the mechanical hardening of iron has not in any great degree diminished its molecular freedom. Even the softest steel shows a high degree of molecular rigidity, as compared with the hardest iron, but far less than that of tempered steel. This would seem to indicate that steel in its softest state is still an alloy, though only feeble quantities of carbon may be held in that condition.

We thus perceive that a great physical change takes place in iron upon the slightest alloy with carbon; and that tempering produces this change in its highest degree. The writer therefore is strongly in favour of the view propounded long since, that steel when tempered is an alloy, containing fixed carbon in a far greater quantity than when soft. We know the physical properties of magnetic oxide of iron, of iron and tungsten, and of iron and sulphur. Now in all these the writer has found that the iron loses its molecular freedom when even slightly alloyed. The physical results are therefore the same as those produced in tempering steel; and the induction balance thus indicates strongly that tempered steel shows the characteristics of a true alloy.

Ollendorff v. The Metropolitan Electric Light and Power Company (Limited).—This motion, which was by the plaintiff, the holder of 100 shares in the company, for the rectification of the registered list of the company's shareholders by the removal therefrom of his name, came before Mr. Justice Chitty in the Chancery Division of the High Court of Justice on Friday week. The plaintiff alleged that he had been induced to subscribe for the shares on the faith of misrepresentations contained in the prospectus issued by the company, by which it appeared that the company was entitled to the exclusive right of using in its district the Lane-Fox incandescent lamp, whereas the fact was that the British Electric Light and Power Company had a concurrent right of using that invention in the same district. Mr. Waller, Q.C., and Mr. F. T. Procter appeared for the plaintiff; and Mr. Romer, Q.C., and Mr. Bradford for the company. Mr. Justice Chitty said that the prospectus issued by the company did not contain any misstatement or suppression of facts. It was a perfectly fair prospectus, and the plaintiff's motion must be dismissed, with costs.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph Engineers and of Electricians.

AN ordinary general meeting of this society was held on Thursday, February 8th, Mr. Willoughby Smith, president, in the chair. The minutes of the last ordinary general meeting having been read and confirmed, and the list of new and proposed members read, a paper by Mr. JAMES GRAVES, member, on "The Magnetic Storm of November 17th, 1882," was read by the secretary.

In his paper Mr. Graves pointed out, that during a portion of the day in question telegraphic communication was entirely stopped by the violence of the currents. The latter continually varied in direction and strength. The results of a series of observations made on an electrometer at Valentia had been plotted out on a diagram, which was shown. The highest potential was noted at 11.21 a.m.

Papers were then read by the secretary on "A Magnetic Storm in India" and on "Earth Currents in India," by G. O. WALKER, member. The paper gave the results of observations taken on a line 200 miles long. This line was of No. 5½ B.W.G., and ran east and west. It was noted that on lines running north and south there was hardly any disturbance. The results of Mr. Walker's observations were shown plotted out on a diagram. As far as could be seen, the moon had no effect whatever in causing earth currents; that regular changes take place, however, is unmistakable.

A paper was then read by Mr. A. J. S. ADAMS, on "Earth Currents (third paper), Sun Spots, and Electric Storms."

The existence of earth currents is very frequent, though they are often so weak as to be almost imperceptible. The fact of the storms being general all over the globe proves that they must be due to external influences. It had been noted that when a spot appeared on the sun a magnetic or electrical disturbance was produced, the opening out of the sun's luminous atmosphere which exposed the nucleus in the form of black spots allowed electrical energy to be radiated which produced the electrical effects. It was noticed that the smaller the spots the less the electrical disturbance.

In the discussion which followed the reading of the paper, Professor ADAMS, F.R.S., stated that a comparison of the photographic records of magnetic disturbances taken at different places over the globe proved that they all exactly corresponded, and were, in fact, simultaneous. In making comparisons of this kind allowance must be made for the fact that the size and magnetic strengths of the needles at the various places might be very different. He considered that the facts obtained are hardly sufficient to place the whole matter on a solid basis. He considered that Mr. Adams's theory of the sun's luminous envelope acting as a shield to the electrical influence was absurd.

Mr. MORGAN thought that the heat of the sun by influencing the atmosphere, which contained magnetic oxygen, might tend to produce currents, and when this heat did not come quite uniformly in consequence of the sun spots, equilibrium being disturbed, currents might be caused to flow.

Mr. PREECE pointed out the importance of care being taken to note with certainty the direction of the earth currents. A person receiving a current from a wire running north would call this current a different name to that received on a wire running south, though if the wires were joined together at that point a continuous current would be flowing.

Mr. WILLOUGHBY SMITH stated that in the 1866 Atlantic cable, on one occasion, an earth current equal in potential to 100 Daniell cells was received at the American end when no trace of a disturbance could be perceived at the Valentia extremity. This fact, though most remarkable was actually the case.

Professors MACLEOD and PERRY, Mr. H. R. KEMPE, and Captain BAGNOLD also took part in the discussion.

The meeting then adjourned.

TO CORRESPONDENTS.

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CORRESPONDENCE.

The Electric Lighting Act.—Provisional Orders.

Your correspondent, G. W. Beckingsale, agrees with me respecting the complexity of the so-called and miscalled "unit," of which the value is 3,600,000 watts, and has accepted the "unit" only for the sake of general uniformity. Relatively to the comparison with the price of gas, the calculation can be made very easily, as follows: The comparison is, of course, only approximative, taking as a standard for the gas the 16-candle five feet burner, and for the electric light the Edison incandescent lamp (16 candles), which expends very nearly *one-tenth* of a horse-power, or 75 watts per second (100 volts and 0·75 ampère), the electric energy furnished to the Edison lamp per hour is

$$75 \times 3{,}600 = 270{,}000 \text{ watts, or } 0{\cdot}075 \text{ unit.}$$

Supposing, to save calculation, a duration of 200 hours of lighting for each: the gas burner will have just consumed $5 \times 200 = 1{,}000$ cubic feet, and cost 3s. 6d. The Edison lamp will have expended $0{\cdot}075 \times 200 = 15$ units. At 7d. the unit, the cost of the Edison lamp would be 8s. 9d. for the electric energy furnished for the same time of lighting and the same quantity of light. Under these conditions the gas is more than *twice* as cheap as the electric lighting by incandescence, but we may expect in the future a less cost for the electric energy supplied and a 16-candle incandescent lamp consuming less energy than the Edison lamp referred to.

I have neglected in this estimation the renewal of the lamp. Putting the *life* of the lamp at 800 hours in normal working, at 4s. each the price of electric lighting will be increased by 1s. for 200 hours, that is, a total amount of 9s. 9d. for 200 hours of electric lighting *versus* 3s. 6d. for the gas lighting. These prices are the true cost of *to-day*, but will not be the true cost of *to-morrow*, and will vary with the price of gas in each country. For example: in Paris the cost of gas is 30 centimes per cubic metre, or nearly 7s. the 1,000 cubic feet. If an electric supply was established in Paris at the same price as aforesaid (7d. the unit), the lighting will cost very nearly the same price, whether by gas or electricity, taking into account the smaller illuminating power of the Paris gas, for the same consumption in burners of the same size.

The conclusion is that the comparison between gas and electricity is a very variable and difficult one, the consumer of electricity must pay for the quantity of energy supplied without any consideration whatever of its better or worse utilisation in lamps or motors, well or badly suited to each special application or to the conditions of supply. I agree with Mr. Beckingsale that the measure of energy should be based on the decimal system and, of course, on electrical units. The megwatt, or the megerg., which is ten times less, fulfil these conditions, although not perfectly, but the "unit" is in no sense convenient, for the reasons explained a fortnight ago.

Simplex.

It is interesting and curious to note that "Simplex" and Mr. E. W. Beckingsale fall into an error precisely similar to that which I pointed out a fortnight ago with reference to electrical accumulators. Both gentlemen confound the *rate* at which energy is delivered with the *quantity* delivered. The former proposes as a unit of energy the watt-ten, the latter a million watts, and both propositions, when interpreted according to the present stage of electrical science, turn out to be meaningless. From the following considerations :—

The amount of energy which has been expended in a circuit is proportional to the product of the quantity and electromotive force. When a constant current of n ampères flows through a circuit, we know that there passes a quantity of electricity equal to n coulombs per second, in the same way as we know that a railway train running at a constant speed of 50 miles per hour passes over 50 miles every hour. But at the end of a certain time n ampères will no more give the quantity of electricity that has passed than 50 miles will give the distance passed over. Both these depend on the time and may be 50 or 5,000, as the case may be. It would be ridiculous to multiply the speed of the train by the load to find the work done ; it is equally ridiculous to multiply the current by the difference of potential, to find the work done. In the former case, the mean speed into the time, *i.e.*, the distance, must be multiplied by the load to get the expenditure of energy ; in the latter case, the mean current into the time, *i.e.*, quantity in coulombs must be multiplied by difference of potential. The speed of the train into the load gives the *rate* at which work is being done at any particular instant, and in the same way, the current into the difference of potential gives the *rate* at which work is being performed at any instant in an electric circuit, but to totalise the work both these rates must be multiplied by the time.

What, then, is a Watt ? It is not a quantity at all. It is simply a rate—the unit rate of doing electrical work—and in Mr. Moulton's unit (1,000 watts for one hour) we have a perfectly intelligible unit, and certainly one of the simplest that could be fixed upon. It is perfectly independent of time—that is to say, 100 Joules may be used to-day and 1,000 a month after, the consumer being charged for the total quantity used during the quarter ; 1,000 watts for one hour is equal to 3,600,000 coulomb-volts, or Joules as they are now termed, a Joule being a unit of work, which, however, is too small where large quantities of energy are concerned.

In conclusion, I fail to see how 1,000,000 watts, or any other expression which does not embrace time, can be employed as a unit of energy. I shall be happy to hear what others have to say on this important subject, for it is high time that perfectly definite meanings be implied by the distinctive terms employed.

E.

[We quite agree with "E." in regard to the practicability of the "unit" proposed by Mr. Moulton.—EDS. ELEC. REV.]

The Elphinstone-Vincent Machine.

In the experiments you kindly record this week the ampères were measured by an ammeter for heavy currents, designed by Mr. F. J. Mudford, and not by one of Ayrton and Perry's, as I inadvertently stated. Ayrton and Perry's ammeter, as far as I know, has not been made to measure more than 200 ampères.

Chas. W. Vincent.

February 12th.

The Industrial Unit of Electrical Energy.

As electrical energy becomes more and more a commercial commodity some convenient mode of measuring it is needed. We have the volt, ohm, ampère, and coulomb, as practical units of E. M. F., R., C., and quantity, but we have no practical unit of work done. Dr. Siemens has lately introduced the watt as a convenient term for the power spent by an ampère under one volt. Thus the watt is the unit of power or rate of doing work—that is to say, 1-746th of a horse-power, and not the amount of work done by an ampère flowing through an ohm for an hour, nor any other measure of energy expended or work done. To meet the want of a proper term, corresponding to the mechanical foot-pound, it is common to talk of hour-volt-ampères ; and quantity, instead of being measured in coulombs, is measured in hour or second-ampères. The current is, of course, a rate of flow, that is, quantity divided by time, and to speak of a quantity as the amount that will pass in a given time at the rate of so much in some other given time is somewhat awkward. Thus 3,600 coulombs are spoken of as an hour-ampère. Practical electrical measurements are analogous to those of a compressible fluid, E. M. F. corresponding to pressure, though the relations of pressure and resistance are different, a gas-pipe only impeding the flow at the outside of the stream. We might as well call a cubic foot of gas at normal pressure the amount which would run through a certain pipe in twelve minutes at the rate of five cubic feet an hour. In dealing with secondary batteries the hour-ampère is still more cumbrous. For electrical work done there is no convenient term ; but as electrical work is always in terms of volt-coulombs, the volt-coulomb, or the work done by a coulomb passing under one volt, seems a desirable unit. The term "vomb" seems to show its origin and meaning, and is at the same time euphonious and impressive. The vomb is, however, small. The megvomb is, then, the measure proposed by Mr. Beckingsale, under the name of megwatt, and is derived from the second as time-unit, and not the hour. A megwatt is a million watts or 1,300 horse-power ; a watt is one vomb per second ; a vomb is ·74 foot-pounds ; a megvomb is 737,000 foot-pounds. A megvomb in ordinary cases costs somewhat under a half-penny. As incandescent lamps take about three watts per candle-power, one megvomb is equal to about 30 cubic feet of 15-candle gas, or with arc lights, practically about 100 cubic feet. In secondary batteries of the Planté or Faure type a megvomb is about the amount of work 2½ pounds of available lead and lead peroxide can give out. Practically, a Faure cell weighing 136 pounds can give over two megvombs, or about a pennyworth.

There seems a chance of great confusion among the electrical units, and quite lately one of the most important electric light companies was reported to have offered to supply electrical energy at the rate of sixpence per thousand erg-hours. There was an N.B. to say that an erg-hour was the amount of energy equal to 1-746th of a horse-power ; but as a horse-power is not energy, the matter is no plainer. An erg is the C. G. S. unit of energy or work, and is exceedingly small. A thousand ergs are almost exactly the amount of work done by an imprintable insect, weighing a sixth of a grain, when jumping up three feet. The only apparent way of connecting hours with ergs is to suppose the company did not wish to be extravagant in plant, and only meant to supply energy at the rate of one nameless insect jump per hour, at the cost of sixpence a jump.

Confusion may also arise presently from different conceptions of potential. An electrician, seeing a wall two feet high from which a weight might fall doing work, would talk of the potential of the top of the wall as 2, whether there was a weight there or not, because a pound falling off would do 2 foot-pounds. If there was a 2-pound weight he would talk of 2 pounds at a potential of 2. But an engineer would not think of potential at all, until there was a weight on the wall. If it was a two-pound weight, he would say it had a potential of 4. Then the word power, which might be taken to mean potential or power of doing work, has come to mean ability to do work at a given speed, and then to mean work done at a given speed, as when we talk of transmission of power. It is also used to denote the application of force to do work, as in a lever in mechanics.

There is an outcry against the numerous units in electricity, but there would be little difficulty if people who felt con-

fused studied the coulomb, volt, ampère, ohm, watt, and above all the vomb; corresponding to volume, pressure, flow friction, power, and work in gas; and left ergs and dynes. It only needed an influential man to introduce the useful watt, and it only needs an influential journal to introduce the vomb.

Jas Swinburne.

Testing Dynamo Machines.

I fear a solution of sulphate of zinc would be somewhat troublesome with so large a current in consequence of the solution of the anode (if of zinc) and the powdery deposit upon the cathode.

The electrical efficiency was calculated from Sir William Thomson's formula. Taking up the case you have quoted, viz., 10 cells of $\cdot1^{\omega}$ internal resistance and 1·5 volts E. M. F., we have, when joined up in series through 1^{ω} external resistance, a current of

$$\frac{10\times1\cdot5}{(10\times\cdot1)+1}=\frac{15}{2}=7\cdot5 \text{ ampères,}$$

as you say; now the difference of potentials at the terminals of the battery would be shown by the voltmeter to be 7·5 volts, and then by calculation we have

$$\frac{7\cdot5 \text{ volts}}{7\cdot5 \text{ ampères}}=1^{\omega};$$

but in the second case we insert a cell (resistance 1^{ω}, E. M. F. 1·5 volts) in place of the 1^{ω} of wire, and in such a way that its E. M. F. shall oppose that of the 10 cells, then we have

$$\frac{(10\times1\cdot5)-1\cdot5}{(10\times\cdot1)+1}=\frac{13\cdot5}{2}=6\cdot75 \text{ ampères,}$$

but the resistance of the cell would be "apparently"

$$\frac{6\cdot75+1\cdot5 \text{ volts}}{6\cdot75 \text{ ampères}}=1\cdot2^{\omega},$$

the difference of potentials indicated by the voltmeter being 8·25 volts.

Of course I must admit that all that appeared to be resistance by calculations based upon readings of ampères and volts would not be so, but at the same time I must confess it seems to me that any calculation based upon the above as an actual resistance would be perfectly accurate.

I cannot help thinking that there must be some misunderstanding between us, which I trust this will clear up, and that our arguments may be instructive to our readers, and if we cannot agree upon anything else we may at least agree to differ. I may say that I am, and shall always, I trust, be obliged to any one for pointing out any probable source of error, as, of course, I am not infallible.

Francis J. Mudford.

[We think it unnecessary to enter any further into this question as we have reasons for stating that Mr. Vincent agrees with our criticism in every point concerning the tests made on the Elphinstone-Vincent machine.

We shall always be pleased to hear from Mr. Mudford on any subject in which he can add to our readers' information. EDS. ELEC. REV.]

Callender's Vulcanised Bitumen Core.

With reference to the four tables of tests taken on the above material, and published by you in last week's issue of the ELECTRICAL REVIEW, I omitted to say that table 3 related to the core supplied for the Marquis of Salisbury's electric light installation at Hatfield, which was covered for underground work.

At the present time there is much need felt for a good insulating material, and the following facts with regard to this core may be of interest to your readers.

An eminent firm of engineers, in making tests to ascertain if this core was suitable for electric light work with large currents passing, suspended a length of 50 ft. of insulated strand of 7-16^{ths} B.W.G., and allowed a current of 190 ampères to flow through it for a period of two hours, the result, of course, being a considerable heating of the copper; the length was left for the night, and on examination next day the centre was found to be in no way affected, although the material had been rendered soft from the heat in the metal.

A tube of the insulator 1½ ft. in length, cut from the same sized core, kept in suspension for 48 hours a weight of 2 lbs. The elongation at the expiration of 24 hours being rather over one inch, and at the end of 48 hours, three inches. On removing the strain the material contracted to within ⅜ths of an inch of the original length. The approximate electrostatic capacity is 4·7, taking G P = 4·2 and I R = 2·8 (air = 1).

The co-efficient for temperature has not yet been accurately determined. Tests for that purpose are being taken at present, the decrease in resistance from 60° to 75° F. appears to be considerably greater than in Willoughby Smith's improved core, and the increase at low temperatures correspondingly greater.

Your impartiality in bringing into notice anything of a promising character must be my excuse for writing at such length.

Basil Gee.

Electrician to Callender's Bitumen Telegraph and Waterproof Company (Limited).

Erith Marshes, Belvedere, Kent,
February 13th, 1883.

Gardner v. Maxim-Weston Electric Light Company.

Looking through your paper on Saturday last I was more than surprised to see what purported to be an explanation from Mr. Hugh Watt, managing director of the Maxim-Weston Electric Light Company, of 47, Cannon Street, E.C., in reference to his conduct towards me when in the employ of the said company.

What I said on oath, in the successful action I took against the company, is true and indisputable, and, more than that, was corroborated by the Secretary of the defendant company, and *not contradicted*, as Mr. Hugh Watt has wrongly stated in his so-called explanation.

James Gardner.

94, St. Paul's Road, Kennington Park, S.E.

[Both parties now having had publicity in our columns this correspondence must close.—EDS. ELEC. REV.]

NOTES.

Electric Lighting.—The Newington Vestry met on Wednesday week, when the clerk reported the receipt of a letter from the agent of the Board of Trade with reference to the application of the vestry for a licence for the electric light, enclosing copy of a memorial from six ratepayers—the committee appointed at a public meeting of ratepayers on the 7th December—on the subject, and asking that the board might be favoured with the vestry's observations thereon. The memorial stated that the parish had decided to apply for the sanction of the board to acquire power to adopt the Electric Lighting Act; that such application was entirely at variance with and contrary to the wishes of the general body of ratepayers, who viewed with alarm and anxiety the desire of the vestry to embark in this most costly and experimental business, in the carrying out of which they would have to borrow and spend large sums of money, which might ultimately be wasted, and which would largely increase the already too heavy burdens of the ratepayers. The board, the memorialists said, would see how unjust it would be to make the inhabitants of the back streets, occupied by the class mentioned, and the remainder of the parish outside the area of supply, subscribe to the cost of an experiment from which they would derive no benefit. After some discussion it was agreed: "That a copy of the letter sent to Mr. Yates—one of the memorialists—be forwarded to the Board of Trade, and also a copy of the report, as adopted by the vestry; and that the Board of Trade be further asked to call upon the memorialists to give a guarantee for costs in the event of a public inquiry being deemed necessary into the prayer of the memorial.

The incandescent lamp appears to be in great favour for new steam-ships of a high class. Messrs. Faraday and Son, of Berners Street, W., have just completed a contract for handsome nickel Swan lamp fittings to be applied in the saloon of steam-ship *Normandie*. This fine vessel, the

property of the Compagnie Transatlantique of Havre, is now fitted throughout with the electric light, by Messrs. Siemens Bros. Messrs. Faraday are also supplying a novel arrangement of electric lamps, combined with the usual candle lamps, for use on the steam-yacht *Empress*, now being fitted in the most elaborate manner at Hull.

The Electric Light Wires and the Saving of Life.—The latest news from America informs us that at recent fires the electric light wires have been the means of saving many lives, by enabling persons in isolated rooms to swing to the ground by their means ! !

The Hon. Sidney Carr Glyn, M.P., has joined the Board of the Hammond Electric Light and Power Supply Company (Limited).

From the *Chronique des Travaux Publics* we learn that the engine of Messrs. Robey & Co., Lincoln, used in the electric lighting of the Brussels House of Parliament, is erected behind the *Moniteur*, on loose ground of La Tribune street. This engine, which has been erected by Mr. Beck, engineer of Brussels, has a horizontal steam boiler superposed by the parts of the engine, which is quite independent of those parts. The whole is readily portable, and erected on the ground without a single bolt for fixing purposes. The absence of masonry, and the extremely small consumption of coal, constitute advantages already appreciated in Belgium by several manufactories, some of which require the utmost regularity in the working.

The Special Committee on Electric Lighting of the Wandsworth Board of Works reported at a meeting of the board last week that they had carefully considered the several provisions contained in the Metropolitan (Brush) Company's electric lighting Order, and had amended the same, and settled the clauses which they considered necessary for the protection of the interests of the board. The company had agreed to limit the operation of the Order to so much of the parish of Clapham as lay to the north and north-east of a line drawn from the south-eastern corner of Wix's Lane along the north side of Clapham Common, the Pavement, and Clapham Park Road as far as its junction with Bedford Road. With regard to the Provisional Order for Wandsworth and Wimbledon, the clerk had sent a letter to the Board of Trade, stating that the Board of Works were willing to consent to the granting of such Order, subject to certain alterations. They were, however, of opinion that the capital of the company was insufficient for the purpose, that a proportional deposit should be made, that "earth returns" should not be sanctioned under any circumstances, and that the prices mentioned in the Order were very excessive, and ought to be subject to modification at a future time. The report was approved.

We understand that the Science and Art Department of South Kensington have just given an order to the Pilsen-Joel and General Electric Light Company for twelve Pilsen arc lamps and the necessary dynamo machines. This order has been given after a careful trial of the working of a Pilsen lamp.

Successful street electric lighting trials have, we learn, been made at Seegedin, a large Hungarian town with about 70,000 inhabitants. The lighting was arranged by the electro-technical factory of Messrs. Ganz & Co., at Budapest, and of the trials the *Neue Freie Presse* says :—"As the most apt area for electric lighting trials a street 845 mètres long has been chosen, which leads to the railway station, and a large *plaza* at the end of this street. In the former there were placed incandescence lamps of 20 C. P. each, at distances from 40 to 40 mètres. The lighting proved surprisingly successful, the light-intensity being much higher than that of the gas-burners, which are placed at much smaller distances than 40 to 40 mètres. Besides these incandescence lamps there were burning at the large *plaza* four arc lamps, which diffused a very brilliant light. Both incandescence and arc lights proved very steady, and the arrangement of the whole plant was very good. The firm (Ganz & Co.) has the merit of having installed for the first time in Austro-Hungary street-lighting by incandescence lamps. The surprising success of the said trial is a very important step in electro-technical progress."

At a meeting of the Rotherhithe Vestry last week, the minutes of the last meeting of the Electric Light Committee were submitted, and it was explained that the clerk had been instructed to give notice to the Board of Trade in order to secure the insertion in the proposed Provisional Order of the Brush Company such clauses as might be deemed necessary, and to forward a copy of the said clauses to the Board of Trade. The clerk intimated that he had carried out the order of the committee, and had received a reply from the Board of Trade to the effect that before the Order was granted an inquiry would be held. The minutes were approved.

The Place de Carrousel is the only street in Paris now electrically lighted at the expense of the municipal exchequer, the Jablochkoff lighting of the Avenue de l'Opéra having been suspended ; but the electric light is daily finding fresh fields of display. A building company, who are erecting a large structure in Paris, propose to manufacture the light on their own premises for their own use, and sell it to their tenants at moderate rates.

Messrs. Copestake, Hughes, Crampton & Co. have, after a trial of the Ferranti system, decided to have the whole of their Nottingham works electrically lighted. One of the largest lace mills in the same town has followed suit.

At Norwich the Ferranti system has been adopted by the Messrs. J. & J. Colman.

The Hammond Company has opened an office at Glasgow, and we learn that arrangements are being made to light the premises of the *Glasgow News*.

Capt. Weskowski, a naval officer, has been entrusted with the electric lighting at the forthcoming coronation of the Czar at Moscow.

Palace-yard will again be lighted by electricity during the session, and it is in contemplation to substitute incandescent electric lamps for gas in the dining and other rooms used by members, though nothing has yet been done in the matter.

The Chelsea Vestry held its meeting on Tuesday afternoon and a letter was read from the Board of Trade, in which it was stated that the Chelsea Electric Lighting Provisional Order, promoted by the Metropolitan (Brush) Electric Lighting Company, would be considered to-day. The question was referred to the Electric Lighting Committee, who were empowered to take all necessary steps for the protection of the interests of the parish. It was stated that this is the first case to be taken under the Electric Lighting Act, and it was understood that the vestry would be represented by Mr. C. Mossop, the Chairman of the Electric Lighting Committee, and Mr. G. H. Stayton, C.E., the surveyor to the vestry, who have hitherto taken the principal part in the matter.

Mr. Frank G. Howard, electrician, informs us that on the evening of the 2nd inst. the Eastern Electric Light and Power Co. introduced successfully incandescent lighting in Egypt, upon the occasion of a grand ball given at the Opera House in Cairo. In the centre of the theatre, upon a handsomely decorated buffet, were placed two immense standard electroliers, in the Arabian style, each supporting 15 Lane-Fox incandescent lamps, lighted by means of 22 Sellon-Volckmar accumulators charged the day before and transported in the evening to the theatre. The light was suddenly turned on at 11 P.M. when the theatre was full, with great effect, the light showing up with dazzling brightness against the gas and candles. The Egyptians were utterly astounded to see the electroliers suddenly burst into a blaze of light, it being the first time they had witnessed anything of the kind. On the following evening the stage was successfully lighted by means of the same accumulators during an entire act in the play, *Le Jour et la Nuit*.

Messrs. Keys Brothers and Sims's establishment in Donegal Street, Belfast, has been for the last month lit up by four Pilsen arc lamps, one being outside and the remainder inside the building. The lights have been put up by Messrs. Woodhouse & Rawson, and have given every satisfaction.

The Electric-Carbon Storage and Apparatus Manufacturing Company of Scotland (Limited) has just received instructions to light up Messrs. J. Mitchell & Son's establishment, Princess Street, Edinburgh, with incandescent

lamps, which will be artistically arranged in monograms, &c., worked by the Forbes' storage batteries, of which this firm has the sole right in Great Britain. Above 200 lamps will be used.

The Council of the Institution of Civil Engineers (Dublin) has awarded a Mullin's silver medal to Mr. Thomas B. Grierson, associate, for his paper on "Electric Lighting by Water Power," read before the Institution on the 7th December, 1881.

The Dalkeith Police Commissioners, at their meeting, had laid before them the report of their lighting committee on the proposal made by the Brush Electric Light and Power Company of Scotland to light the town by electricity. It was stated that, after investigation, it was calculated that 100 lamps would be required, the cost of which would amount to £2,502 per annum, as compared with an annual expenditure of £240 for the existing 300 lamps.

At the monthly meeting of the Broughty Ferry Police Commissioners, on Monday, it was reported that Mr. Beckingsale, general manager to the Brush Electric Light and Power Company (Scotland) was present at a committee meeting held on the 17th ult., and gave explanations as to his proposed system of lighting; that, after discussion, Mr. Beckingsale was invited to send in an offer for the experimental lighting of Brook Street, on the distinct understanding that this was merely for the information of the commissioners, and that no further information had been received from the company.

The Kirkcaldy Town Council, after considering the proposals of the Brush Electric Light and Power Company of Scotland for lighting their town, have decided to do nothing in the meantime.

The Proposed Aberdeen Telephone Company.—Colonel H. R. Jackson, chairman of the National Telephone Company, addressed a public meeting in the music hall, Aberdeen, on Thursday, the 1st inst., on the proposed company. Accepting the suggestion of the Lord Provost, that an arrangement of a satisfactory character should be made with the existing company, the gallant colonel said they should be quite certain that they could get telephonic communication at a less rate than the National Company could supply it at before they called in the assistance of another company. His company were willing to give over the control of the Aberdeen system to a committee of local gentlemen, and would be content with a profit of 10 per cent. Of course, only the working of the system would be in the hands of the committee. The company would give the means requisite for extending the system, and such information as they possessed, having the advantages of trying experiments with wires and instruments in London. They should also consider the question of probable litigation. As to royalties, a company working a telephone must do one of two things—buy their telephones or pay a royalty for them. The Dundee Company owned their telephones, and the Aberdeen people had been informed that they could get telephones at £10 a-piece. The United Telephone Company supplied them at £1 per telephone per annum; but he must not mislead them—the £1 was for each transmitter and receiver, and it took two of them to make a telephone, so that the United Telephone Company's royalty was £2 for what they would, if they purchased their telephones, have to pay £10. For the £2 they got the best telephone of the day, and when it wore out it was replaced by another without charge. If the United Telephone Company possessed a patent for any telephone which was better than that which the subscriber was using he could return the worse and receive the better instrument without paying anything, so that he always had the best telephone of the day for £2 per annum. Was it, therefore, better to pay £10 for a thing that in the progress of invention might become obsolete, or pay £2 for a royalty and use, for a telephone which would be changed for others if anything better was discovered?

At the close of the meeting a committee was appointed to confer with Colonel Jackson, and we understand that an arrangement satisfactory to both parties has been arrived at. The heads of the agreement practically accepted and submitted to a legal adviser for drafting, are that the company shall receive £10 yearly rental for each subscriber; the company in no case taking more than 10 per cent. return on their outlay. If the business can be shown to be capable of being worked by the local committee at a less cost than £10 per subscriber, the members of the exchange will mutually benefit by the return so effected. On the Saturday another conference took place between the committee and Colonel Jackson. We learn that a draft agreement was submitted by Colonel Jackson, setting forth the conditions on which the management of the Aberdeen Exchange would be intrusted to a local board. This statement provided that the agreement between the parties should commence on the 1st March, 1883, and continue until the 30th June, 1888; failing twelve months notice by the company to the contrary, they should be bound to continue if required by at least 300 subscribers. Each subscriber, it was stipulated, should receive a lease expiring on 30th June, 1888, and the company were to intrust the whole management of the exchange to a local board of three members, the board having power to regulate the local arrangements and expenditure; to appoint and dismiss all officials and servants, the district manager excepted, who should be appointed or dismissed only with the consent of the company.

The capital expended by the company in Aberdeen prior to the date of the agreement, it was provided, should be ascertained and fixed to the satisfaction of the Local Board, and the plant for extensions and such renewals as were fairly chargeable to capital should be provided at the cost of the company. Out of the revenue from subscribers the Local Board should pay all annual charges incurred in Aberdeen for working the exchanges, including such maintenance charged for repairs, depreciation of plant, and renewals, as were fairly chargeable to revenue; and they would also pay 10 per cent. interest on the company's capital. The subscriptions should be fixed annually in advance for each exchange connection, the rate to be limited to £10 per annum for the period to June 30th, 1884. If this should produce insufficient revenue to meet the charges and interest, the company to bear the loss; and if there was a surplus it should be returned to the subscribers rateably. Subscriptions for the following years to be fixed by the Local Board, and to be sufficient to meet revenue and interest charges. Any deficit to be carried forward and reckoned in fixing next year's subscriptions. Modifications and free charges not to be allowed, except to "charities" approved by the Local Board, and no reductions for second connections.

At a meeting of the committee on the following Monday evening a further communication was read from Colonel Jackson, in which he stated that he was not prepared to accept the terms proposed by the promoters of the local company.

It is understood that the Committee will report in favour of the formation of a local company, as they believe that instruments of the best description can be got, and the necessary plant at moderate prices, and that with economical management telephonic communication can be established, as is the case in Dundee, at considerably lower rates than those charged by the National Telephone Company. With reference to litigation Messrs. Webster and Styring, solicitors for Messrs. Tasker, Sons, & Co., Sheffield, write to the Aberdeen daily press that the decision of Mr. Justice Fry interrupted the action against their client, Mr. John Tasker, on the application by the United Telephone Company for leave to disclaim certain portions of the Edison patent. Mr. Tasker opposed this in July last, and obtained protection for a certain number of instruments which the United Telephone Company, Limited, considered infringements of Edison's patent. Since that time nothing has been heard of the action, and the solicitors say that the proposed new company in Aberdeen may purchase the necessary instruments from Messrs. Tasker, Son, & Co. without the slightest risk of any law-suit by the United Telephone Company.

An adjourned meeting of subscribers and others interested in telephonic communication in Aberdeen, was held in that city on Thursday week, when the report of the committee appointed at the first meeting held on the 1st inst. to confer with Colonel Jackson, the chairman of the National Telephone Company, was submitted. Colonel Jackson, the committee said, submitted to them a proposal to modify the existing tariff as follows:—1. The annual rent of each connection

within the limit of one mile from the Telephonic Exchange to be reduced to £10, payable in advance. 2. A lease of three or five years, at subscribers' option, to be given to the subscriber, having right to break the lease at the end of the first year on payment of a penalty of £5. 3. Existing subscribers to be entitled to the benefit of the new tariff by substituting a new lease for their current agreements. The committee were of opinion that these terms should be accepted at the present time as satisfactory, subject to adjustment of minor details, and on the understanding that all subscribers receive the benefit of any modification of the tariff which might be made during the currency of their leases. After a long discussion the report was allowed to lie on the table.

Prof. Ayrton on Electric Locomotion.—Under the auspices of the Glasgow Science Lectures Association, Prof. W. E. Ayrton, F.R.S., spoke to a large audience in St. Andrew's Hall on the evening of the 8th inst. on the subject of "Electric Locomotion." Mr. Thomas Russell, of Ascog, occupied the chair, and among other gentlemen on the platform were Sir William Thomson, Sir William Collins, Profs. Jack, Thomson, and M'Kendrick, Principal Jamieson, &c. In introducing Prof. Ayrton, the Chairman observed that that gentleman was not unknown in Glasgow, as he passed some considerable time in this city under our distinguished townsman, Sir William Thomson. Prof. Ayrton then proceeded with his lecture, which was freely illustrated with experiments produced by stored electricity. At the outset he stated some of the well-known difficulties besetting the electric transmission of power, and the means that electrical engineers had proposed for overcoming those difficulties. About two years ago, he went on to say, the storage of electric energy came prominently into notice, when some three or four boxes of the fluid (?) were sent to Sir William Thomson. Some people thought that the affair was merely one of those nine days' wonders of which we had had so many recently; but scientific men saw in it immense possibilities. One of the latest developments of the use of stored electricity was the boat running on the Thames, and the electric tricycle, one of which was on exhibition. Tramway cars were being driven by the same sort of power both in London and Paris, only experimentally yet, however. The lecturer next spoke of the Portrush Electric Railway, and explained at some length the improvements which had recently been effected in the working of that and similar lines. He afterwards went down the length of the hall on the tricycle, to the evident delight of those present. Prof. Ayrton concluded his remarks by pointing out that electric tricycles could not as yet become popular, by reason of the difficulty of getting the stored electricity renewed when the supply was exhausted. When, however, the time came that the tricyclist could dismount at his inn with the certainty of getting a supply, then a tour on an electric tricycle would be made possible, and when that time came—and he believed it was not far distant—he felt sure that the sum for electricity would be the smallest item in the tourists' bill. Sir William Thomson proposed a vote of thanks to the lecturer, and this was cordially responded to.

The Society of Telegraph Engineers and of Electricians.—At the next meeting of the society a paper will be read "On the Measurement of Electricity for Commercial Purposes," by James N. Shoolbred, member.

Gas v. Electricity.—At the half-yearly meeting of the shareholders of the Gas Light and Coke Company (Limited), held last week, the chairman admitted that he was no prophet, and therefore abstained from making any remark on the future of the electric light. While assuring his hearers that there was no ground for apprehension, he acknowledged that he does not look to illuminating so much as to the cooking purposes of gas to compensate the company for any loss they may sustain from the electric light.

Personal.—Mr. Alex. Peebles has joined the board of the Metropolitan Brush Electric Light and Power Company (Limited), in place of Mr. Alderman Whitehead resigned.

The Electric Railway Extension.—The Lambeth Vestry met on Thursday week, and agreed, on the recommendation of the Parliamentary Committee, to "oppose the Charing Cross and Waterloo Electric Railway Company's scheme, unless clauses satisfactory to the officers of the vestry be arranged with the company."

Magneto-Electric and Dynamo-Electric Machines.—At a meeting of the Institution of Civil Engineers, held in Dublin on Thursday week, a discussion took place on a paper on magneto-electric and dynamo-electric machines, which had been read on a previous occasion by Mr. J. Angelo Fahie, C.E. Mr. Fahie now illustrated his paper by experiments with electrical machines. He described the electrical railway between Portrush and the Giant's Causeway, and produced a miniature carriage, which, propelled by electricity, ran with remarkable smoothness on a pair of brass rails 10 or 12 yards long. The discussion will be continued at the next meeting of the institution.

The Misdeeds of Electricity.—Our French correspondent writes:—"Electricity has a broad back, and when the cause of an accident is not known it is the rule of the advanced press to attribute it to electricity. Here are two articles which appeared in the same number of a leading Parisian journal, that of the 9th inst.:—

"Lyons, February 7th.—Two *employés* of the Parc de la Tête d'Or were sent yesterday morning to remove the floral decorations which had been used to ornament the *salle* of the Théâtre Bellecour, where the students' annual ball had taken place. These *employés* had the imprudence to drink from some bottles left under the benches in the orchestra, one of which contained *a preparation intended for the electrical apparatus (?)*. Both these unfortunate persons died during the day.

"There was a great panic last Friday at the Grand Opera House of Milwaukee, at New York, during the representation of 'Lights o' London.' At the third act the electric light machine, which was placed upon the stage, exploded with great force, causing terror in the *salle*, which contained 600 persons, &c."

Electricity must be very tenacious to life to resist such attacks.

The United Telephone Co. v. Harrison, Cox-Walker & Co.—Messrs. Harrison, Cox-Walker and Co. have given notice of appeal to the House of Lords.

Cable Interrupted.—Telegraphic communication was again interrupted last week by the failure of the String Sound cable. The cable worked by Colonel Balfour, of Balfour Castle, will be used *pro tem.*

Suppression of Press Telegrams.—The correspondent of the *Glasgow North British Daily Mail*, who had been sent to Skye in connection with the Crofter agitation, sends the following telegram: "Dunvegan, Sunday. The Postmaster of Portree is delaying press telegrams."

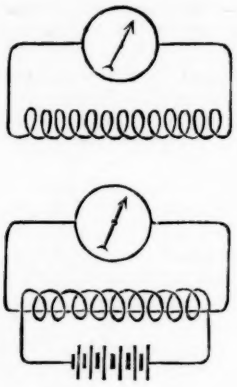
The Telephone in Dundee.—A movement is on foot in Dundee to establish telephonic communication between all the public offices in that town.

Sewing by Electricity.—Mr. Wm. Whitlet, sewing-machine manufacturer, Dundee, has fitted up on his premises a Griscom motor for working his machines. The experiment is attracting much attention.

Berly's British, American, and Continental Electrical Directory and Advertiser.—Many of our readers doubtless made the acquaintance of Mr. Berly's "Electrical Directory of England," published last year. Whilst compiling that work of two hundred and odd pages, the author considered that the importance of the subject was such as to induce him to extend his operations to America and the Continent, and the result has been the production of the directory with the above title. We do not intend to review Mr. Berly's book here, but we may safely say, that however much his first effort was appreciated, this second, and vastly more comprehensive, directory will be found invaluable to

electricians or engineers engaged in the electrical world in any capacity whatsoever. The work, which contains more than three times the number of pages comprised in the first edition, is published by Messrs. Dawson and Sons, 121, Cannon Street, and may also be obtained at the offices of the ELECTRICAL REVIEW; in New York, of Geo. Cumming, 218, East 18th Street; and in Berlin, of Berth.-Mendel, W. Lützow Str., 84. For further particulars see page 13 of our advertising columns.

Magnetism.—We read in the New York *Electrician* that Prof. A. E. Dolbear, of Tuft's College, near Boston, has made an important discovery. If a galvanometer be placed between the terminals of a circuit of homogeneous iron wire, and heat be applied, no electrical effect will be observed; but if the structure of the iron is altered by alternate bending, or twisting to a helix, as shown in the sketch, and heat applied, then the galvanometer



will indicate the presence of an electrical current in the wire. The professor used a circuit of homogeneous iron wire, and the application of heat produced no electrical current in the wire. A portion of the wire was surrounded by a helix, and connected with a battery; the current in these wires magnetised the circuit wire where it was surrounded by the helix; under these circumstances, the galvanometer showed the presence of electricity in the main circuit: as it is well known, that upon the application of heat to a circuit of un-homogeneous material, a current is produced, and this experiment showed that a current was produced in the circuit, only when a portion was magnetised. These experiments prove that magnetism must be connected with some molecular change of the metal magnetised.

OFFICIAL RETURNS OF ELECTRIC COMPANIES.

Edison Gower-Bell Telephone Company (Limited).—The second return of this company, made up to 31st ult., was filed on the 7th inst. The nominal capital is £500,000, in £1 shares. 365,007 shares have been taken up, and upon 15,000 of these a call of £1 per share has been made and paid, the remainder of the shares being issued as fully paid. The total paid-up capital is £365,007. Registered office, 6, Lombard Street.

Electrical Insulator Manufacturing Company (Limited).—The return of this company, made up to the 2nd of December, was filed on the 15th ult. The nominal capital is £100,000, in £1 shares. 19,371 shares have been allotted; upon 5,296 15s. per share has been called, and the full amount upon the remaining 14,075. The calls paid amount to £16,547 and unpaid to £1,500. Registered office, 31, Lombard Street.

Ferranti, Thompson, and Ince Company (Limited).—The return of this company, made up to 18th ult., was filed on the 26th ult. The nominal capital is £240,000, divided into 12,000 A and 36,000 B shares of £5 each. 12,000 A shares have been taken up and £2 per share has been called and paid up thereon. The B shares have not yet been allotted. Registered office, 3, Fenchurch Avenue, E.C.

General Telegraphic News Company (Limited).—The return of this company, made up to 19th October, 1882, was filed on the 19th ult. The nominal capital is £80,000, in £10 shares; but the only shares recorded as taken up are the seven subscribed for by the signatories to the memorandum and Articles of Association. A special resolution has also been filed stating that at the meetings of the company held on the 21st December and 11th of January it was resolved that the company be wound-up voluntarily.

NEW PATENTS—1883.

393. "Photometer." A. J. BEER. Dated January 24.

549. "Improvements in the construction of electric brushes, in the composition of the exciting liquids, and in the means and appliances in connection therewith." M. MCMULLIN. Dated February 1.

555. "Electrical conductors." J. IMRAY. (Communicated by the Société Anonyme des Cables Electriques—système Berthoud, Borel & Cie.) Dated February 1.

559. "Dynamo-electric machines." W. P. THOMPSON. (Communicated by J. A. I. Craig.) Dated February 1.

592. "Galvanic batteries." P. R. DE FANCHEUX D'HUMY. Dated February 3.

594. "Telephones." G. H. BASSANO, A. E. SLATER, and F. T. HOLLINS. Dated February 3.

598. "Galvanic batteries." H. THAME. Dated February 3.

612. "Manufacture of covered wire for electrical purposes and machinery or apparatus therefor." W. HALKYARD. Dated February 5. (*Complete.*)

614. "Electric generators." J. A. FLEMING. Dated February 5.

623. "Apparatus for measuring and regulating currents of electricity." P. CARDEW. Dated February 5.

628. "An improved dynamo-electric or electro-dynamic machine." R. W. MUNRO. (Communicated by A. E. Swoninkoff.) Dated February 5.

629. "Voltaic batteries." L. LARCHIN. (Communicated by L. Hartmann.) Dated February 5.

631. "Electric lighting apparatus for railway and other carriages." A. M. CLARK. (Communicated by N. de Kabath.) Dated February 5.

632. "Storage batteries or electrical accumulators." J. H. JOHNSON. (Communicated by J. A. MALONEY.) Dated February 6.

633. "Improvements in the manufacture of finely-divided lead, lead alloys, and compounds of the same for use in secondary batteries and for other purposes and in apparatus employed in such manufacture." W. CROSS. Dated February 6.

634. "Apparatus for regulating electric lamps, electric currents, electric potentials, and the supply of electric energy." A. GRAY and T. GRAY. Dated February 6.

639. "Electric lamps." J. G. LORRAIN. Dated February 6.

648. "An improved method for the adaptation of the incandescent electric lamp to stage and other purposes where such lamp is required to be portable." W. J. SAWARD and A. KOERBER. Dated February 6.

659. "Voltaic batteries." W. R. LAKE. (Communicated by J. M. Stebbins.) Dated February 6.

661. "Dynamo-electric machines." J. MUNRO. Dated February 6.

666. "An improved apparatus to facilitate hearing and speaking simultaneously." H. MARLOW. Dated February 6.

676. "Telephonic apparatus." H. H. ELDRED. Dated February 7.

681. "Electric meters." C. V. BOYS and H. H. CUNYNGHAME. Dated February 7.

698. "Apparatus, appliance, or switch for electric lamps, and other electrical connections, for making and breaking electric contact." J. T. TODMAN. Dated February 8.

699. "Moulds for moulding or shaping bulbs for incandescent electric lamps, and other articles of glass." A. SWAN. Dated February 8.

719. "Electric safety plugs and appliances in connection therewith." K. W. HEDGES. Dated February 9.

764. "Manufacture of carbon filaments for incandescing electric lamps." G. BOWRON and W. HIBBERT. Dated February 12.

791. "Secondary or storage batteries." F. ROWAN. Dated February 13.

792. "Improvements in dynamo-electric machines and electric motors, and in electric current distributors." T. ROWAN and S. WILLIAMS. Dated February 13.

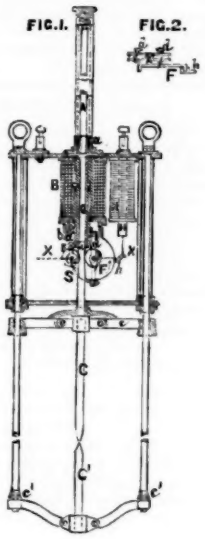
797. "Improvements in dynamo-electric and magneto-electric machinery and in gearing for use therewith." F. WYNNE. Dated February 13.

804. "Construction of dynamo-electric machines, partly applicable also to other purposes." H. T. BARNETT. Dated February 14.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1882.

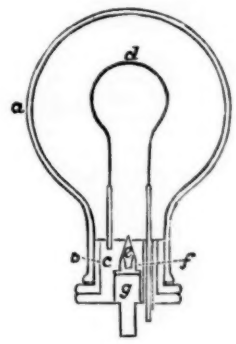
2723. "Electric lamps." C. G. GUMPEL. Dated June 9. 6d. Relates to a construction and arrangement of electric lamp with automatic feed of the electrodes and formation and regulation of the arc in a simple and compact form. Fig. 1 is a vertical section and fig. 2

FIG.1. FIG.2.



is a plan on x x of one form of electric lamp according to the invention. c and c^1 are the carbons, the lower, c^1, fixed in its holder and the upper, c, fixed to a guided holder, *e*, which is attached to a rod or tube, A, that passes up through the middle of a solenoid, B, and is counterbalanced by a weight, *a*, connected to it by cords passing over pulleys. Within the solenoid, B, is fitted free to slide a non-magnetic tube, D, carrying a light frame, *d*, on which is pivoted a bell-crank lever, E, carrying one of the hollowed pressing rollers, *e*, and in which is mounted the other pressing roller, *f*, having on its axis a feed-wheel, F. The horizontal arm of the bell crank, E, is linked to an iron tube, G, which forms the movable core of the solenoid, B. A canting pawl, *h*, attached to the core, H, of the solenoid, K, engages the rim of the wheel, F. The descent of the frame, *d*, is limited by a stop, *b*, and a spring, *s*, acts as a brake to the feed wheel, F. When the carbons, c c^1, are in contact and the lamp is put in circuit, the current passes freely through the carbons and also through the coil of B, which is of low resistance in the lamp circuit. The core, G, being then attracted upwards by moving the bell crank, E, causes the roller, *e*, to press against the rod, A, so that the rod is gripped between *e* and *f*, and by the continued ascent of the core, G, the rod, A, and holder, *c*, are raised lifting the upper carbon, c, away from the lower carbon and establishing the arc between c, and c^1. When owing to consumption of the carbons the resistance of the arc increases, then a greater portion of the current passes through the coil of K, which is of high reristance in a by-pass circuit. The core, H, being then drawn upwards its pawl, *h*, clamping the rim of the wheel, F, turns it partly round in the direction of the arrow, causing the carbon, c, to descend. When the resistance of the arc is thus reduced, the solenoid, K, becomes comparatively inert, and its core, H, descends the pawl, *h*, slipping along the rim of F. Thus by the action of the solenoids, B and K, the regulation and feed of the carbons are automatically effected. When the carbons are nearly consumed, sockets at the ends of the holder, *e*, make contact with springs, e^1, short-circuiting the lamp current.

2752. "Electric lamps." J. LANE. Dated June 12. 6d. In electric lamps in which the light-emitting portion is contained in vacuo or in a closed chamber or globe containing gases which are non-supporters of combustion and more particularly in that class of electric lamps known as incandescent lamps, the light emitting portion or lighting medium is connected to a conductor or conductors passing through and united by fusion to the glass either in the shape of an auxiliary tube which is fused to the glass of the lamp, or to the globe itself, a separate opening being formed to permit the vacuum to be produced, which opening is also sealed by fusion, the whole becoming practically one glass case or chamber with the wires or conductors extending therefrom. In the construction of such lamps, however, difficulties have been experienced in passing wires other than those of small area or light section through, or into the glass, or in using wires composed of a cheaper metal than platinum by reason of the difference in the shrinkage or expansion of the metal and glass after they have been fused together. In lamps of the above-mentioned construction any defect either in the manufacture of the lamp or in the incandescent medium or light emitting portion itself, or arising from the oxygen of the air finding its way into the interior of the lamp, and so causing the consumption of the light emitting portion or from any other cause involves the loss or waste of the entire lamp. The main objects of the invention are to remedy this disadvantage, to facilitate the manufacture of such lamps, to reduce the cost thereof, and to enable any defect arising from any cause to be repaired or made good at a small cost. The fig. is a central section of one form of the improved lamps; *a* represents the ordinary enclosing glass globe or chamber which may be of any suitable form. To the mouth or neck of this globe is connected in an air tight manner a ring or collar, *b*, of any suitable material. To this ring or collar is attached also in an air tight manner a removable plug or cap, *c*, which carries all the necessary connections with the light emitting portion or lighting medium, *d*. Through the said plug or cap, *c*, is formed a passage or opening which affords access to the glass globe or chamber, *a*, and within this passage or opening is arranged a valve or stopper, *e*, of any convenient form, and adapted to come in contact with a seat of corresponding form in the said passage or opening. When a vacuum



has been produced in the globe, *a*, or as soon as the non-combustible gases have been introduced therein preferably in the manner, and by the means hereinafter described, the said valve or plug, *e*, is sealed in an air tight manner, by employing therefor at *f* any suitable sealing material, such as wax or the like, for instance.

2756. "Voltaic batteries." C. G. GUMPEL. Dated June 12. 6d. Relates to a construction of voltaic batteries, either primary or secondary, so as to render them conveniently portable in order that they may be readily moved from place to place, and to the arrangement, in combination with such batteries, of electric lamps applicable for lighting in mines, houses, carriages, ships, and elsewhere. For this purpose the inventor builds up a pile in such a manner that the liquids or other substances employed retain their relative positions in whatever attitude the pile may be placed, without risk of fluid escaping or of being pressed out from between the plates forming the elements, or of loss of current by short-circuiting any of the elements.

2759. "Electric lamps." H. H. LAKE. (Communicated from abroad by R. R. Moffatt, of America.) Dated June 12. 6d. Relates to arc lamps. One object of the said invention is to provide a novel, simple, and effective means for controlling the feeding of the movable carbon. To this end the said invention partly consists in an electric lamp comprising the combination of an electro-magnet in the main circuit, an armature therefore having connected to it means for gripping, raising, and holding a rod, whereby the movable carbon is supported, a toothed rack on the said rod, one or more gear wheels in engagement with the said rack, a ratchet or other driving wheel, an electro-magnet in a derived circuit, and an armature therefore having connected to it a pawl or dog, which, on the raising of this armature, will act on such driving wheel to impart motion thereto, and thereby effect the feeding of the said carbon, but at other times will leave said wheel free.

2760. "Posts or supports for telegraph wires, &c." H. H. LAKE. (A communication from abroad by J. G. Richard, of Paris.) Dated June 12. 2d. Consists in isolating the foot or base of the post from the ground and destructive elements by enclosing the part of the said post which is susceptible of being attacked by the humidity of the earth, in an impermeable box, cylinder, base, or block. (*Provisional only.*)

2762. "Voltaic batteries." D. G. FITZ-GERALD. Dated June 12. 2d. Relates to improvements in voltaic batteries. According to the invention, the inventor uses as a depolarising agent in primary voltaic batteries, peroxide of lead under pressure or in a strongly compressed condition. The positive element of the battery is preferably either tin, iron, or lead, which metals may be employed in a more or less spongy or porous condition. The negative element is preferably either carbon, such as gas-carbon or graphite, or lead, either of which conductors is by means of considerable pressure maintained in close contact with a layer of the above-mentioned depolarising agent. Dilute sulphuric acid or a solution of ammonic sulphate may be employed as the electrolyte. (*Provisional only.*)

2763. "Manufacture of peroxide of lead, &c." D. G. FITZ-GERALD. Dated June 12. 2d. Relates to improvements in the manufacture of peroxide of lead and reduction of certain metals. According to one portion of the invention, the inventor treats certain salts and insoluble compounds of lead in admixture with an electrolyte which may be a salt of a metal other than lead, by subjecting them to electrolysis in a tank or in a series of tanks containing suitable electrodes. The anode within the tank or tanks is preferably formed of plates of gas-carbon or graphite, the plates constituting each anode being connected together either by means of plugs or connecting pieces of carbon beneath the surface of the fluid, or by means of contact screws and wires above such surface. The cathode may be a plate of metal such as lead, which is not acted upon by the

electrolyte. In this process peroxide of lead is produced at the anode whilst a metal such as lead or tin is reduced at the cathode and in certain cases an alkali such as sodic or potassic hydrate is also obtained at the cathode. A porous partition or diaphragm may be placed between the electrodes. (*Provisional only.*)

2769. "Dynamo-electric and electro-dynamic machines." J. IMRAY. (Communicated from abroad by Paul Jablochkoff of Paris.) Dated June 13. 6d. Relates to the apparatus described in No. 257, of the ELECTRICAL REVIEW for October 28, 1882.

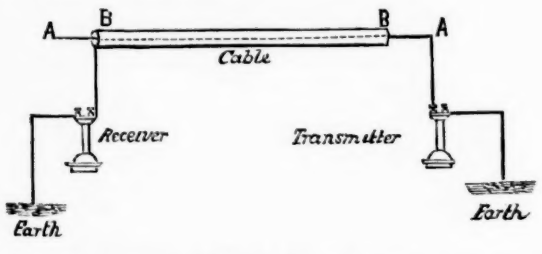
2771. "Dynamo-electric machines." J. FARQUHARSON. Dated June 13. 4d. The object of this invention is an improved method of developing magnetic force in soft iron by means of an electric current. The means employed consists in placing soft iron between as well as beneath the layers of insulated wire forming the electric circuit; by this means the second and following layers outwards forming the coils or bobbins are brought nearer the iron than heretofore.

2776. "Manufacturing carbons applicable for electric candles, &c." F. H. VARLEY. Dated June 13. 6d. The object of this invention is the production of carbon rods, poles, or plates of required size or form, of solid, perforated, or cellular structure, suitable for electric light candles, or plates or poles in galvanic batteries, secondary batteries, or accumulators. The invention consists mainly in calcining or charring vegetable or other fibres saturated with a hydrocarbon substance or fluid twisted into rope or string, plaited into bobbin or gimp woven into fabrics, or knitted or felted together, according to the special purpose intended in their subsequent employment.

2781. "Electric lighting apparatus." W. R. LAKE. (Communicated from abroad by C. F. de la Roche, of Paris). Dated June 13. Relates to improvements in voltaic arc lamps, and has for its object to provide a very simple lamp in which the carbons abut against a ring or other suitable stop, the feed movement of the said carbons being produced by means of springs or counterpoises instead of by clockwork mechanism or other complicated apparatus usually employed for regulating the position of the carbons.

2803. "Dynamo-electric machines." F. L. WILLARD. Dated June 14. 6d. Consists of improvements in Dynamo-electric machines. As the current derivable from the revolving armature is dependent upon the intensity of the magnetic field and the closeness with which such armature can be made to revolve within it, the inventor so constructs his field or inducing magnets, as to shroud or close in the armature, on nearly all sides. The field magnets may consist of cast, or wrought, or malleable iron, and they are wound in such a manner, as to cause the poles to have an intense magnetic effect upon the armature revolving within them. The armature consists of several cast or wrought or malleable iron rings, having collars, shrunk or forged upon their sides, so that the coils which are wound in the spaces between such collars may be brought out flush, or level with such collars. Lugs are cast, or forged upon the sides of these rings, for the purpose of bolting them together; and the whole are then bolted to two brass cheek plates, through which a fixed pin or spindle passes, and on which the cheek-plates with the armature composed of the before-described rings turns.

2804. "Employing electricity for telegraphic and telephonic purposes." W. R. LAKE. (A communication from abroad by F. Van Rysselberghe, of Schaerbeck, Belgium.) Dated June 14. 6d. Hitherto telephonic communication has been established either by a single conductor grounded at the two extremities and containing the receiver and the transmitter in its circuit, or by two parallel conductors forming one closed circuit which contains the receiver and the transmitter; electricity being, in each case, utilised in its dynamic condition and travelling through the circuit as a current. The improvements consist essentially in establishing each telephonic communication by means of two conductors, one of which, by preference, surrounds or envelops the other, and which are insulated from each other and from surrounding bodies; and in utilising such a system, not as a conducting circuit, but as a condenser, in which



electricity acts in its static condition. The inventor effects this by connecting one end of the internal conductor with the transmitter, the other end of that conductor remaining insulated at the receiving station; and connecting one end of the external conductor with the receiver, the other end of that conductor remaining insulated at the transmitting station. The figure represents a telephonic installation in which the transmitter is a simple telephonic apparatus, as is also the receiver. The cable, A, is in communication with the transmitter, and the cable, B, with the receiver, these two cables being insulated from one another. At the transmitting station the conductor, A, is placed in communication with the transmitter which is grounded, whilst the conductor, B, remains insulated. At the receiving station the conductor, A, is insulated, but the conductor, B, is placed in communication with the receiver which is grounded. In this manner the currents sent by the transmitter are condensed and thus rendered inactive in the conductor, A; but the result is that electric currents are caused to pass through the receiver to charge the other conductor. Instead of a conductor, B, enveloping a conductor, A, two parallel wires can be employed. By this method the effects of induction and of derivation, so injurious in telephony, will be avoided. Neither of the two conductors forms a complete circuit, and the electricity instead of acting in a dynamic state acts in a static state by condensation.

2807. "Secondary batteries." L. EPSTEIN. Dated June 14. 4d. Has for its object improvements in secondary batteries. Each cell of secondary battery consists of an outer vessel of wood or other material, and a porous cell within it; between the exterior of the porous cell and the sides of the outer vessel is placed a spiral scroll of sheet lead of several convolutions. Within the porous cell is placed a similar scroll of a smaller diameter. These scrolls form the electrodes of the cell. To charge the battery a saturated solution of permanganate of potash is prepared, and to this is added ten per cent. of sulphuric acid and ten per cent. of methylated spirit.

2818. "Secondary batteries." J. S. SELLON. Dated June 15. 4d. Relates to the preparation of plates for secondary batteries, and consists in making perforations or interstices in such plates of such a form that the material with which the perforations or interstices are packed will be keyed or firmly retained in position by the shape of such perforations or interstices. This object may be effected by so constructing the punches or instruments with which the perforations or interstices are made as that when operated upon the plates they will form perforations or interstices of the shape required, or the perforations or interstices may be first made in the ordinary way and afterwards countersunk or otherwise altered in shape to secure the same result, or the moulds in which the plates are cast may be so formed that a form of hole or interstice such, for instance, as a single or double cone is produced, thus effecting the purpose required.

2845. "Incandescent lamps." A. PFANHUCHE. Dated June 16. 2d. The main object of the invention is to provide a sure and convenient means of attaching and connecting the conducting wires to the burner or luminous bridge of an incandescent lamp. For this purpose the inventor makes the said bridge or burner hollow and inserts the ends of the wires a suitable distance therein, or otherwise surrounds the ends of the wires with the threads or strands of the burner or filament if made twisted and not hollow. (*Provisional only.*)

2871. "Dynamo-electric machines." J. E. H. GORDON. Dated June 17. 6d. Relates to the machine described in No. 257 of the ELECTRICAL REVIEW for October 28, 1882.

2875. "Gas batteries and apparatus for producing hydrogen and oxygen by electricity." R. J. GÜLCHER. Dated June 17. 6d. Consists first in the use in gas batteries of hydrogen and oxygen gases under considerable pressure. Consists further of improvements in apparatus of the kind known as "Grove's gas battery," the object of the said improvements being to cause the hydrogen and oxygen gases to be generated and compressed to a considerable degree simultaneously and by the same action, whereby the said apparatus is rendered capable of practical use as a secondary battery or as a generator and reservoir of the said gases. According to this part of the said invention, the inventor forms a vessel of some suitable air tight and non-conducting material which he divides internally into three compartments (which are termed the first, second, and third compartments), by means of partitions which descend nearly to the bottom of the said vessel, the spaces between the lower edges of the said partitions, and the bottom of the said vessel forming the only means of communication between the several compartments. In the top of the said vessel openings are joined which communicate each with one of the said compartments, and in the lower part of the third compartment is formed another opening slightly above the level of the lower part of the said partitions, which openings are provided with means for producing an air tight closure. In the first and second of the said three compartments is placed the pair of platinum plates (each in a separate compartment), the lower edges of the said plates being slightly above the level of the lower edges of the aforesaid partitions, and wires or other suitable conductors connected to the said plates are passed through apertures in the top of the vessel, and the said apertures are sealed air tight. All the compartments of the vessel are then filled with slightly acid water through the openings in the top thereof, and those are closed which communicate with the first and second compartments, and those closed in the third compartment, the liquid in which compartment then flows out to the level of the lower opening, the liquid in the other compartments being prevented from flowing out by atmospheric pressure. The openings in the upper and lower parts of the said third compartment are then closed, and the apparatus is ready for use.

2877. "Electrical apparatus for ascertaining the depth of water, &c." W. R. LAKE. (Communicated from abroad by L. G. Coffinières de Nordeck, of Paris.) Dated June 17. 2d. A weight of sufficient size draws along at the bottom of the water a gauge or manometer whose needle communicates by a metallic circuit with the sea. This needle moves in proportion to the increase in the pressure and comes successively into contact, during its movement, with metallic pins or pieces fixed in a plate or piece of metal. The said metallic plate and pins are connected to the sounding line or cable by an insulated conducting wire, and are insulated from the needle and from the sea. The sea and the said insulated conducting wire are included in an electrical circuit when the pressure rises in the gauge or manometer, and its needle comes in contact with one of the aforesaid metallic pins; but when such pressure decreases, the said pins, in the return movement of the needle, are only touched by a piece or part of insulating material which prevents the passage of the electrical current. The manometer thus constructed is protected from the water by a water-tight case, its orifice only communicates with the sea whose pressure influences it. The contacts actuate an indicating dial. (*Provisional only.*)

2896. "Shunts or switches for protecting electrical instruments from the effects of excessively powerful currents." C. T. HOWARD. Dated June 19. 6d. Relates to an improved shunt or switch, which is arranged to cut off all electric currents from the interior of dwellings or other buildings whenever it is desired to do so on account of a thunder storm, or when the air is excessively charged with electricity, and which will also carry off any excessive currents accidentally produced, either by atmospheric electricity, the contact of telegraph or telephone wires, with wires charged with electricity of a high tension, or from other causes, without entering the building. The said invention comprises a shunt or switch placed around, or in close proximity to, a plate connected with the ground, and a movable bridge operated from the interior of the building, whereby the electric current can be shunted from the instrument and from the interior of the building or connected with the same, and in which a portion of any abnormally powerful current of electricity will be automatically carried to the ground whether the connection is made with the instrument or not.

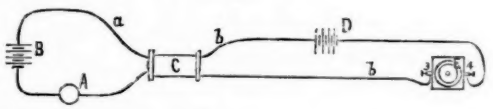
2898. "Incandescent electric lamps." A. SWAN. Dated June 19. 6d. Has for its object the simplification of the means whereby the glass and wire portions of incandescent electric lamps are produced or combined.

2902. "Electric meters." J. T. SPRAGUE. Dated June 19. 4d. Relates in the first place to the employment of such chemical reactions set up by electric currents as set free a gas or gases, usually the decomposition of water in presence of acids or other agents, to facilitate conduction and electrolysis. Another portion of the improvements relates to measurement of electric currents by means of the weight of a metal deposited.

2905. "Telephone receiver." W. H. SNELL. Dated June 20. 2d. In this receiver the diaphragm is polarised and is acted upon by a flat helix of wire parallel to it, in which the current travels. (*Provisional only.*)

2907. "Electric telephony." J. G. LORRAIN. (A communication from abroad by A. Dunand, of Paris.) Dated June 20. 6d. The said invention relating to improvements in electric telephony has reference to an arrangement and combination of apparatus whereby articulate speech may be transmitted and reproduced with greater clearness and intensity than heretofore. In carrying out the said invention a condenser or series of condensers, such as that used in the base of an induction coil, is employed as the receiving telephone in combination with a battery, both arranged in the circuit of the secondary wire of an induction coil, a microphone, or other transmitter, with its battery being arranged in circuit with the primary wire of the said coil. Fig. 1 is a diagram illustrating the simplest

FIG. 1.



arrangement of the apparatus, *videlicit*, that in which a single instrument only (transmitter or receiver as the case may be) is used at one station. Figs. 2 and 3 illustrate the arrangement of a compound condenser which may be used, fig. 2 being a front elevation and fig. 3 a longitudinal section of one form of compound condenser. Referring to fig. 1, A represents a microphone or other transmitter arranged in the circuit of the battery, B, and primary wire, *a*, of the small induction coil, C, at the transmitting station; *b* is the secondary wire of the said coil, one end of which communicates with the line and with a battery, D, and thence with one of the two series of plates or armatures forming the condenser, E, which constitutes the receiver at the receiving station, the other end of the secondary wire communicating with the other series of plates or armatures of the condenser. The current from the battery, B, passing through the

FIG. 2.

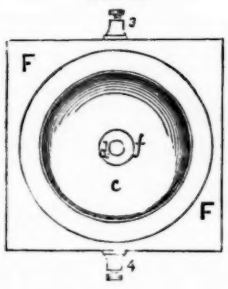
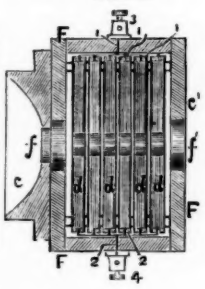


FIG. 3.



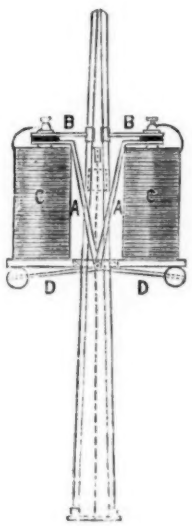
primary wire of the induction coil is modified or varied under the action of the voice by means of the microphone or other transmitter, A, interposed in this circuit. This variation or undulation of the current in the primary circuit causes electrical variations or undulations to be set up in the secondary wire, which increases or decreases the charge of the condensers causing them to speak or emit sounds. When both a transmitter and receiver are required at the same station, an induction coil is used at each station, its primary wire containing the transmitter and transmitter battery as hereinbefore described, whilst the two receiving condensers are arranged in the circuit of the secondary wire of the two coils with a single battery in the same circuit common to the two, or a battery for each may be employed if found desirable. The condensers employed are of the kind used in the base of induction coils as before mentioned and consist of thin sheets of a conducting material, such, for example, as tin foil alternating with thin sheets of insulating material, such, for example, as paper, a sheet of tin foil being interposed between each two sheets of paper and the alternate plates of tin foil being connected together so as to form two series of plates or armatures with which the opposite ends of the secondary wire respectively communicate as hereinbefore explained. In practice the inventor finds that the condensers which give the best results are those composed of alternate sheets of tin foil and thin paper, such, for example, as tissue paper, or the paper may be dispensed with and the leaves of tin foil be insulated by a varnish. The two exterior surfaces of the condenser are by preference formed of a thin sheet of strong sonorous material, such, for example, as card board, vulcanite, glass, celluloid, or metal, which may be provided with an opening. In the arrangement represented in figs. 2 and 3 the condensers, *d d d*, are disposed parallel to each other, a short distance apart, in a box, F; the alternate sheets of tin foil are respectively connected at the opposite sides by wires, 1, 2, with the two binding screws, 3, 4, communicating with the two extremities of the secondary wire of the induction coil, a battery being interposed in the circuit as hereinbefore described. On one side of the box, F, is a cover, *c*, with an opening, *f*, which may be placed against one ear; on the other side is a cover, c^1, having an opening, f^1, over which may be fixed a flexible acoustic tube to be applied to the other ear.

2910. "Apparatus for generating and utilising electricity." C. E. KELWAY. Dated June 20. 2d. Relates to machinery or apparatus used for the purpose of generating a current or currents of electricity, in which one or more armatures of soft iron are made to revolve in close proximity to fixed permanent magnets or electro-magnets. It has for its object novel methods of arranging and actuating such machinery or apparatus, so that a current or currents of electricity of the desired magnitude may be produced by a much slower speed of revolution of the apparatus than is usual in such apparatus as heretofore ordinarily constructed and used. (*Provisional only.*)

2912. "Apparatus for the regulation of electric currents." S. H. EMMENS. Dated June 20. 6d. Is designed to enable electric currents of varying quantity and intensity to be converted into currents of uniform steadiness. This the inventor accomplishes by interposing between the generator and the service circuit two or more sets of secondary batteries, so arranged that whilst one set is being charged by the generator, another is being discharged by the service circuit, and *vice versâ* alternately. The change of connections necessary to effect this, takes place before the current from the discharging set weakens.

2913. "Secondary batteries." S. H. EMMENS. Dated June 20. 6d. Relates to improvements in the structure of electrodes for secondary batteries, whereby a large surface is comprised within a small space, and further to a method of charging. In the improved battery the inventor employs narrow strips of sheet lead or lead foil. These strips he coils into flat coils, or into hollow cylinders with the planes of division at right angles to the axes of the cylinders. Where the strips are in the form of cylinders, they may be annular, or they may be laterally coiled from a straight strip, notched so as to facilitate the coiling.

2914. "Electric lamps." S. H. EMMENS. Dated June 20. 6d. Relates to certain improvements whereby the carbons of an electric "candle" are made to approach one another on the diminution or



cessation of the electric current, and whereby an automatic feed of the carbons, in candle or other lamps, is provided. The first part of the invention consists of an apparatus whereby the carbons of an electric candle are made to approach one another on the diminution or cessation of the electric current, and may conveniently be in the form of a pair of levers, A A, jointed scissor wise, and having at one pair of extremities arms to hold the parallel candles of the lamp. The levers holding the candles are held in open position by the attraction of an electro-magnet, C C, formed by the passage of the lamp current, so long as this current is flowing and the lamp

remains luminous. The hanging extremities, D D, of the scissor levers are weighted or fitted with springs which are insufficient to overcome the attraction of the electro-magnet whilst the current is operative, but which, immediately upon the cessation or sensible diminution of the current and consequent inoperation of the magnet, cause the arms, B B, holding the candles to approach one another, and the candles to converge and complete the circuit, when the magnet again becomes operative, and maintains the candles in their normal and parallel position.

2917. "Dynamo-electric machines." T. PARKER and P. B. ELWELL. Dated June 20. 4d. Relates firstly to the armature, the object being to reduce the useless portion of the inductor and to screen it from inverse magnetic action. Secondly, to the mode of collecting the current from the revolving armature. The patent also relates to electro-motors and to secondary batteries. (*Provisional only.*)

2943. "Primary and secondary galvanic batteries and cells, &c." H. ARON. Dated June 21. 4d. Is based on the hitherto unknown property of chemical derivatives of cellulose, such as gun-cotton and collodium, to form with most metallic oxides or salts a material which, under certain condition, conducts electric currents. This material, hereinafter called the oxide compound, may be reduced by chemicals or galvanic currents, so as to convert the metallic oxide into metal and the derivatives of cellulose into cellulose. Strongly reducing agents produce from the nitro-compound an amido-compound of cellulose, from which reaction results a substance hereinafter called the metallic compound. In order to increase the conducting-power and solidity of the oxide compound it may be mechanically mixed with carbon. The oxide compound may also be produced by mixing with collodium salts soluble in alcohol, allowing this mixture to be sucked up by plates of textile material, and placing these plates in a solution of metallic salt which forms the oxide compound by the decomposition of the salts in the collodium. Instead of the collodium other solutions of gun-cotton may be employed, and of metals applicable for making the oxide-compound may be mentioned silver, platinum, lead, and manganese. For constructing primary galvanic elements a plate of conducting material, little or not attackable by the exciting liquid, is covered with a fresh emulsion of the oxide-compound and allowed to dry. Thicker and stronger plates may be obtained by spreading the emulsion over strips of wood, cotton, or silk-stuff, wrapping the same around the above described plates of lead or other conducting material and using the thus obtained plate as positive electrode, while zinc plates are used as negative electrodes. As exciting liquids the chemicals generally used in galvanic cells may be employed—for instance, diluted sulphuric acid where the electrodes consist of lead-oxide compound and zinc. Instead of using one oxide-compound plate several thin plates may be placed side by side. For secondary galvanic elements or batteries the lead-oxide compound is preferably used, and the pole-plates or electrodes may be prepared as described for primary batteries. The cellulose, uniformly deposited between the metallic particles, carries the liquid into the depth of the plates by capillary attraction, in consequence of which the action is no longer limited to the surface, but can be increased at will by increasing the thickness of the plates. The metallic compound may also be produced by mixing metal in a fine state of division with collodium, or other solutions of cellulose, and this material may be used for making conducting pole-plates or electrodes as described.

2945. "Plates for secondary or storage batteries." C. SORLEY. Dated June 21. 4d. These plates are constructed of suitable material, say lead for preference, and of suitable shape and size. The special feature in them is certain grooves cut or formed in any

convenient direction upon or in the surface of the plate. A rough or feather edge is produced preferably by undercutting the groove, and this rough edge is peculiarly subject to oxidation. The fig. shows the arrangement.

2954. "Apparatus for measuring electric currents." C. A CARUS-WILSON. Dated June 21. 2d. Consists in the application of the principle of electrical endosmose for the purpose of measuring electric currents. In order to effect this the inventor employs two vessels separated by a porous partition or membrane and filled with a suitable liquid in which electrodes are plunged, and he combines with these vessels apparatus for registering the amount of liquid which, under the action of endosmose produced by the passage of an electric current, flows from one vessel to the other. (*Provisional only*).

CITY NOTES, REPORTS, MEETINGS, &c.

The Direct United States Cable Company (Limited).

THE eleventh ordinary general meeting of this company was held at the Cannon Street Hotel, Cannon Street, on Friday, the 9th inst., at 11·30 a.m., "To receive the report of the directors, and the accounts for the six months ending 31st December, 1882, to elect an auditor, and to transact other business of the company." Mr. John Pender, M.P., the chairman of the company, presided.

The directors' report and accounts, a summary of which we have already published, having been taken as read,

The Chairman after quoting from the report, said: The revenue of the 2s. tariff exhibits an increase of £12,955 over that of the corresponding period of 1881, but a comparison of the sums is unreliable, owing to the 1s. tariff having been in operation during the five months ending December, 1881, and also owing to the arrangements concluded in May last with the American companies. The revenue of the present tariff of 2s. may, however, be considered very satisfactory. Turning to the items of expenditure, it will be seen that the expenses in London (£2,781 0s. 2d.) remain practically the same as in 1881, but the expenses at stations (£11,484 4s. 5d.) exhibit a substantial reduction, amounting to about £3,400, due principally to the arrangement entered into with the Western Union Telegraph Company in May last. The only item showing any appreciable increase is that of repairs and renewals to buildings. On the whole the working and other expenditures show a reduction of £2,788 as compared with the corresponding period of 1881. The present market value of the company's investments on account of reserve fund, &c., standing in the balance sheet at £296,053 12s. 5d. is now about £307,000, or say £11,000, equal to 4 per cent. more than they cost the company. The annual interest from these investments will therefore amount to about £11,000. These figures, I think, must be very satisfactory to you, and as the past half year has been rather a remarkable one, I have thought it necessary to go perhaps a little more into detail to-day than I usually do, so that you may not only understand exactly the position which your company occupies at the present moment, but also that you may have a fair idea of the state of the Atlantic telegraphy as well. When I last had the pleasure of addressing you, six months ago, there were many rumours of further competition from new cables. We had just concluded an agreement with the American Cable Company, and a working arrangement with the Western Union Telegraph Company of America. We had given the 1s. tariff a fair trial, and the result was so unsatisfactory that the various companies interested were obliged to revert to the 2s. tariff. We are now more convinced than ever that the 1s. tariff does not sufficiently influence the public to make them increase the number of their messages to such an extent as would give us the same amount of money at 1s. as we can earn at 2s. In short, the 1s. tariff would not yield enough to enable us to pay much more than our ordinary working expenses. We then found ourselves in the face of a new threatened competition—which had been talked of, perhaps, more in America than in England—connected with two powerful interests, the one being headed by Mr. Garrett, the chairman of the Baltimore and Ohio Railway, and the other by Mr. Bennett, of the *New York Herald*, two men occupying prominent positions. They complained that, owing to the fresh cable arrangements, they were placed entirely in the power of the Western Union Telegraph Company, and that it would be impossible for them to carry on, the one an independent line and the other an independent system for his paper, with success, unless they had the privilege of sending their messages on the same terms as they enjoyed with the Western Union Telegraph Company or had cables of their own. I found it difficult to meet the argument, and with the view of better understanding the whole position, and also with the view to having our arrangement modified if possible, so as to have an independent system of Atlantic telegraphy, your board, after a thorough consideration of the question, came to the conclusion that I should proceed to America and fully inquire into the whole question. I therefore proceeded to America. On my arrival I found that the Western Telegraph Company had entered into an agreement with the American Cable Company, so that the former company was literally working and controlling on the American side of the Atlantic all the cable traffic; and I found merchants and newspaper proprietors and others denouncing what they called the vast monopoly which had been established, and which was regarded by them as very detrimental to their interests. I represented this state of affairs to some of the leading members of the Western Company; but before going into the question—before entering into any discussion with them as to the best mode of altering it—I resolved to visit, as far as it was possible to do, the Western Union system. I wanted to judge for myself whether they were entitled to the high position which they held in America, and therefore I started upon what I may call my cruise upon wheels. I may mention, that I travelled 9,000 miles while I was in America, and that at every point that I stopped, even where the population was very sparse, I found the Western Company represented. And here let me take advantage of this, the first opportunity I have had since my return, to express my cordial thanks to the heads of the various railway systems in that country for the extraordinary facilities they afforded me over their various railways, and for the great attention and courtesy which I invariably met with at their hands (applause). I may say that I, accompanied by one or two American friends, had every possible luxury, and that our carriage over the 9,000 miles was done without one shilling of cost to this company (applause). The cost was entirely defrayed by the American railway systems. I think that fact is most creditable to the railway systems in America; at all events, we can do nothing of the kind in this country, and I am sure you will agree with me that at a meeting like this, where I am addressing our shareholders, we should one and all recognise the generous treatment your

chairman received (applause). I also especially desire to take this opportunity to convey my heartfelt and best thanks to the Western Union Telegraph Company. At New York the president, Mr. Green, and the general manager, and at Chicago, the general superintendent, and in fact all whom I met connected with the company were unceasing, and they were successful in their efforts to make my visit to their country both interesting and instructive. I visited some of the most important cities, and a vast track of territory yet unoccupied, but in the course of being developed, more particularly that portion which the Northern Pacific Line traverses. Along the whole route the territory is very much as nature made it, but at the various stations along the route towns are springing up which in a few years are likely to become important centres of population. The population seems to accumulate there by leaps and bounds; but even in parts where population had only began I found that the Western Union Telegraph Company had established offices; in short, I was struck with the omnipresence of their system. That its system not only covered an enormous area, but that it is well and efficiently worked, was to my mind an undoubted fact, and if the American people could be satisfied with one telegraph system, I believe the work could not possibly be done better than it is done by the Western Union Company. At all the leading important towns, in fact, are stationed men of the highest intelligence—men who have not only developed the Western Union Company, but have also made an important position for it and themselves. This fact alone gave me great confidence in the working of the Western Union system, and I felt that the arrangements we had made with that company were fully justified as enabling us through its transatlantic cables to reach all points throughout the United States and Canada with the least possible delay. On the other hand, I found there were many who thought the monopoly injurious, and who were more or less instrumental in getting up small competing lines. I felt it would have been better, probably, if the Western Union Company had not attempted to purchase those lines as they had been in the habit of doing, for the reason that there will always be numbers of the public, however perfect a system may be, who desire to have two strings to their bow (hear, hear), and the contrast between these small companies and the Western Union Company, showed that the Western Union Company could work more efficiently than the small companies; and, therefore, it was really benefited by these light competitions rather than was injured. This I have strongly represented to the Western Union Company. I have always held that opinion in regard to large and small companies, and I hold it now, and I think it has been proved correct, so far as the public are concerned, in the system of telegraphy over which I have the honour to preside (hear, hear). Having satisfied myself of the efficiency of the Western Union system, with an endeavour, so far as I could, to avert the competition, I called upon Mr. Garrett, the chairman of the Baltimore and Ohio Railway, who is a man at the very head of the railway companies in America—a man of high honour and integrity—a man very much esteemed and valued by the people of Baltimore. I had the honour of making his acquaintance in England, and I received from him a thoroughly hearty welcome. I went into the question of the competition which he was about to establish with Mr. Bennett. I explained the policy which I thought might, if carried out, suit his and Mr. Bennett's purpose quite as well as putting down cables of their own. The result of the conversation was, that he said he would be satisfied if that policy was carried out, and that, at all events, he would be disposed to give it a fair trial. I afterwards had a similar conversation with Mr. Bennett, the result of which was pretty much the same, so that, so far as what I may call the Garrett-Bennett opposition, I believe that, for a time at least, it is at an end. However, I do not say that upon any distinct authority from these gentlemen, but upon the fact that they have now made such arrangements as show that they are going to give the system I suggested a fair trial. I may also mention that we have established an independent office in New York, entirely free from the control, directly or indirectly, of the Western Union Company. That office is worked by the Direct Company and by the French Company, and I may explain that in so far as the arrangements with the French Company go we have received most cordial co-operation. We have found the French Company loyal in every way. I went over to Paris on my return from America, and reported the result of my mission, and received a most hearty recognition of what had been done, and an expression of thorough appreciation of the advantages which would likely result from the new policy. I think the establishment of the independent office in New York ought to satisfy, not only the American telegraphing public generally, but also those instrumental in bringing out the small companies to compete with the Western Union Company. I have thought it desirable to refer to my visit to America and to the Western Union system, because it is a system only to be compared with our own system in England. There is this difference, that being worked with profit and enterprise, the Western Union Company has done more in the last ten years to develop the electrical science—they have done more to reduce the rates than the British Government has done. I would therefore strongly recommend our Government to take a leaf out of the Western Union Company's management. Having said so much about the telegraph system of America, I must now say, I believe, to have a thoroughly efficient system of telegraphy, not only between New York and Europe, but between New York and the vast territories of America, the telegraphing must be worked under special arrangements. It would never answer if any new company had power to stop any message. To be universal the system must be organised. This has always been the policy of your board, and I trust we shall always continue to develop such a system. I have had some experience in our Eastern cable system in which, owing to the working arrangements there is uniformity throughout, and at the present moment there is no important centre of commerce throughout the world that is not connected by telegraph, and the system is now worked without any stop. That is the best evidence I can give you of the importance of universality in telegraphy. To illustrate this I may refer to an incident which occurred on the morning of Sir Garnet Wolseley's decisive victory in Egypt. At about ten o'clock, American time, the train in which I was, stopped at a little station on Indian territory, in Nebraska, and I received a despatch informing me of the English victory, and I was able to telegraph at that very place, where civilisation was only dawning, my congratulations to Sir Garnet in the land of the pyramids, and these telegrams were exchanged in less time than was represented by the difference of hours between the two points. I may now say that probably our Atlantic system was never in a more satisfactory position than it is at the present moment. There are eight cables. All the companies are working amicably. We are working at a moderate tariff, and have, as I have said, established an independent office in New York to meet the requirements of those who felt there ought to be two distinct systems; and I cannot see at the present moment any excuse for laying additional cables, because all the reasonable requirements of the general public have been met by the policy we have now carried out. With regard to the threatened competition—the Garrett-Bennett scheme—I think that that is now for the present put aside. I may, therefore, congratulate you, and the Atlantic companies generally, on having before us, for some time at least, freedom from that dread of new cables which has so materially damaged the value of our property in the market. There has also been an idea that if any one were to lay Atlantic cables the existing companies would be sure to step in and purchase them at a profit. I think I may say without hesitation, that the time when that could be done has gone past. It is true that an extraordinary transaction took place between the American Cable Company and the Western Union Company, which gave an enormous profit to the former; but I do not think such a transaction is likely to take place again, and it would be well for those who have an idea of promoting companies with the view of getting large profits, to remember that the present cables are quite capable of doing more than double the present traffic. Although I have no fear of the Anglo-American Company, which is, after all, the senior Atlantic cable company, having four cables, and receiving the largest share of the receipts, I may mention that the managing director has throughout been consulted on all matters, and that he is thoroughly in accord with us in the policy we have so successfully carried out, but the suggestion of the policy and the questions of carrying it out rests with the Direct Cable Company. It may be well to say a few words as to the value of Atlantic cables, as you constantly hear the cry that the capitals are largely watered. No doubt the capitals of the different companies have been largely watered, but this water has been put in at the request of the shareholders themselves—a policy I never approved of—but the real question is not the question of watering but the question of the value of the cables to-day. Take the Anglo-American Company. It has four cables, three of which are comparatively young. The fourth or best cable is the oldest cable at the present moment operating in the Atlantic. The Anglo-American Company spent £90,000 in repairs last summer, and established the fact that a cable twelve years old could be picked up in 2,000 fathoms, which proved that the strength of the cable still exists. We know the gutta-percha does not decay, and we may assume this twelve years old cable may be as good for the next twelve years. This also establishes the fact that submarine telegraph cables may be now considered good property. Those four cables of the Anglo-American Company would cost to replace at the present moment from three and a half to four millions sterling; but then there is the goodwill, which is worth a very considerable sum. As you are aware, the Anglo-American Company hold a monopoly of the shortest route, and therefore it is very difficult to put a price upon the value of the concession. At all events, it being the pioneer company—I myself was one of the earliest associated with the Atlantic telegraph enterprise—the Atlantic Telegraph Company—it is entitled to a monetary consideration from the fact that it was the first to establish submarine cables being laid and worked successfully in such deep waters as exist in the Atlantic (hear, hear). Now we will take the French Cable Company. The capital of that company is £1,680,000. It has one cable only which has cost them this large sum of money, and what is the market value to-day? Why, about £800,000. The Direct Company's capital has been the least watered of any, and what watering there is was introduced into it before the present board had anything to do with it. To replace our entire cable to-day would cost about £900,000. The value of the shares in the market stand at about £800,000. It is now nearly six years since the management has been in our hands, during which period we have regularly paid a dividend of 5 per cent. per annum, and in the same period we have placed £290,000 to the revenue out of the earnings of the company (applause). At the same rate of progress, in another six or seven years we shall have enough money to procure a new main cable, and as our knowledge of cables is daily becoming more complete, I hope by the time our revenue fund is sufficient for a new cable, our present cable will work and will be likely to last, in which case we should be able to afford laying another cable, and the interest from our investment revenue fund would provide us with a large revenue in addition to the ordinary revenue of the existing cable. We should then have two sources of revenue. The most remarkable company is the American Cable Company. They made two cables which cost them less than £1,400,000. They leased them to the Western Union Company for 50 years upon a valuation of £2,800,000, at 5 per cent. on this increased value, or 10 per cent. on the original cost; but notwithstanding this high rate of interest, and the nature of the bargain, which restores to them, at the end of 50 years, their cables in as perfect working order as they now are—the market value of these cables to-day is about £1,900,000. So it matters little what the thing cost. What you have to take is the real value of it in the market. The public are quite sharp enough to draw their own conclusions, and I have found them on the whole pretty accurate. To conclude, there is no better telegraph service in the world than the Atlantic service. I believe the public generally are now satisfied,

and I hope we shall so develop the traffic as to be able to increase our revenue, if not our dividends, but, whether one or both, to increase the value of the property and public confidence in it as an investment. With these remarks I beg to move that the report of the directors with the statement of accounts be adopted.

Mr. Ford seconded.

The Chairman intimated that if any shareholder had any question to ask he should be glad to answer it.

Mr. Griffiths thought the chairman's report of his visit to America very satisfactory. Considering the importance of the speech as a whole, he would suggest that it be printed and a copy of it sent to each member of the company.

Mr. Newton should have desired a little more time for their meeting, their time being limited in consequence of the Anglo-American in an adjoining room. He thought they should acknowledge the cordial reception of their chairman in America. The expression of their acknowledgment, he was of opinion, would be welcomed by the American companies (hear, hear).

The Chairman: Previous to this occasion, we generally held our meeting at mid-day and the Anglo-American at two o'clock. I know there are many of you anxious to go there, and I am only sorry my remarks have kept you so long ("no, no").

The report was unanimously adopted.

Mr. Jackson moved that Mr. John Sawyer, F.C.A., be elected one of the auditors of the company in the room of his deceased brother, Mr. Joseph Sawyer. Mr. John Sawyer was the shareholders' nominee and representative, and he was satisfied he was the most efficient gentleman for the post, being acquainted with the accounts. As a stockholder he should like to say that he had always thought that the certificate of the auditors was rather meagre and bare, not that it was by any means necessary under the present board to have fuller details, but still they might come to be under the management of a different stamp, and then it might be of advantage to the shareholders to have a detailed certificate.

A Shareholder seconded this motion.

Mr. Griffiths (auditor): Our duties have been very fully fulfilled, I can assure you. We have examined everything that it is possible to examine to prove the accuracy of the accounts, and I have been thoroughly satisfied with them. I myself do not care to have a long certificate. If I detail some of the work I have done, questions may be asked me if I have done more or not. As a matter of fact, I have done everything I consider necessary to satisfy myself of the accuracy of the accounts, and I can say of this company especially that everything is in the most perfect order.

The motion was unanimously carried.

Mr. John Sawyer returned thanks for his appointment.

A vote of thanks to the chairman concluded the meeting.

Anglo-American Telegraph Company (Limited).

THE ordinary general half-yearly meeting of the proprietors of the above company was held in the City Terminus Hotel, Cannon Street, on Friday, the 9th inst., the Hon. Robert Grimston presiding in the absence, through illness, of the chairman of the company, the Rt. Hon. Viscount Monck.

The Secretary, Mr. T. H. Wells, having read the notice convening the meeting, the minutes of the previous meeting were read and approved.

The Chairman said: I presume, Gentlemen, you will take the report as read ("Agreed!"). In the unavoidable absence of your chairman, Lord Monck, I regret to say through illness, I have been requested to take the chair upon the present occasion. I must ask for your kind indulgence in so doing, and I hope you will take the will for the deed. In one respect I appear before you under very happy auspices, and that is that all our cables are in good working order (hear, hear). When we met six months ago our Brest cable, or as it is generally called our '69 cable, was broken in mid-ocean, and a gentleman, who assumed the name of an ex-stockholder, went to the trouble and expense of circulating amonst the proprietors two letters, in which he prophesied that the '69 cable never would be repaired, that it was practically defunct and utterly useless. A man who prophesies about submarine cables is a very bold man indeed. He ought to remember the old distich,

> "The easiest way to increase your store
> Is to prophesy after and not before."

Within a very few weeks of the ex-stockholder's prophecies, all his prophecies were falsified. The '69 cable was repaired, and it has worked splendidly ever since. It carries on an average 4,000 words a day, and it could carry treble that number if it were required (hear, hear). Now, gentlemen, the cost of repairing this Brest cable has been very large indeed, very much larger than your directors had any reason to anticipate when we sent out the expedition to do it. In some respects we were somewhat unfortunate. Upon two occasions when the work was very nearly completed, in fact I have been told that another hour would have done it, the wind got up and the cable had to be buoyed. The storm carried away the buoys, and all the grappling had to be gone over again. The result of this was that this expedition lasted between four and five months, and what with the value of the new cable that was expended on it, it has come to the large sum of more than £90,000. Well, gentlemen, we did not have to go to borrow this money at a high rate of interest for we had got the money in our renewal fund, and the whole and entire cost of this costly expedition will be borne by that fund (hear, hear). Now consider, gentlemen, for one moment what would have been the position of this company if we had never had a renewal fund. When our '65 cable failed we should not have been able to replace it with a new cable as we have done; and, again, when our '66 cable failed we should not have been able to replace that with a new cable as we have done, and without the money in our till I do not think that we should have ventured to have sent out a costly expedition to repair this '69 cable, so that we should have been a company with one cable, and that nearly ten years' old. That, gentlemen, would have been the position of the Anglo-American Telegraph Company, if you, gentlemen, had not had the prudence to sanction the additions that we have made from time to time to the renewal fund. Thanks to the renewal fund, we have now four good cables in working order. In the 7th paragraph of this report, allusion is made to our having raised the tariff from 1s. to 2s. a word. I wish to make just a few remarks upon that subject. We were induced by the wishes of the public to make the experiment of the shilling tariff. I must admit that I was one of those sanguine persons (if you will not put a harsher term upon it) to believe that the shilling rate would amply repay the companies, and would ultimately become the tariff of the future. We tried this experiment for ten months, and I was most grievously disappointed. The public who were ready enough to cry out for the reduction of the tariff, were not quite so ready to bear their share of the expense. They did not support us in the manner which we had a right to expect them to support so liberal a reduction. In the ten months during which we carried at the shilling rate, as compared with the corresponding ten months at the higher rate, not this company only, but the joint purse lost £290,000, or at the rate of very nearly £1,000 per day. Well, gentlemen, is it any wonder, is it a thing to be surprised at, that we entered into an arrangement with Mr. Jay-Gould, part of which arrangement was that the tariff was to be put up to 2s.? The public, I am sure, had no right to complain. They did not support us, they forced us into it. I have here a comparative statement of the tariff after we had raised it to 2s., and the tariff before we had raised it to 2s.; and it is very instructive. In August, 1882, our receipts were £79,430; in August, 1881, at the 1s. tariff, they were £51,690. In September, 1882, £85,850, as against £51,920; in October, £93,740, against £52,440; in November, £89,390, against £49,860. (There is a difference, those two months, of £40,000 each.) In December they were £78,150, against £50,280, and last month, January, £83,930, against £47,630, altogether an increase for the six months of £206,670. Is it then, gentlemen, to be wondered at that we entered into an arrangement with Mr. Jay-Gould? With respect to the accounts, I think that there is very little to remark. The only thing is that in salaries and wages there is a saving of rather more than £550. In the general balance sheet there is one item that requires some explanation. "To sundry creditors, £125,731." The fact is that we have not yet paid to the Telegraph Construction and Maintenance Company an account of £80,000 pending its adjustment, but we have got the money already on deposit, and I can say that we shall make the payment some time probably in the course of next week. There is one other matter on which I wish to say a word, and that is that I regret to have to announce the resignation of my friend Mr. Rate, a gentleman in whom I have the very highest and greatest confidence, and up whom I rely very much for advice at all times. I regret to say that he has now retired from the board. The directors elected in his place Mr. Cunard, a gentleman who is well known to all people who have anything to do with Atlantic telegraphy (hear, hear), and I trust that he will worthily fill the place that Mr. Rate occupied. Gentlemen, I will now move the adoption of the report and accompanying statement of accounts up to December 31, 1882, and that the following dividends, all free from income tax, be now declared, *i.e.*, a balance dividend of 1 per cent. on the ordinary stock for the year, making, with the previous payments, 2¾ per cent. for the year on that stock, and secondly a balance dividend of 2 per cent. on preferred stock, making, with the previous payments, 5½ per cent. on that stock for the year ending 31st December, 1882.

Sir Daniel Gooch seconded the adoption of the report.

Mr. Brown asked how it was that the deferred shareholders had not had something given them, seeing that there was a sum of £36,000 over and above the corresponding period of the previous year.

The Chairman said that there was not a sufficient balance of revenue account to pay any addition beyond what had been proposed.

Mr. Newton said that he was sorry the meeting of this company had not been arranged so as not to clash with that of the Direct United States Cable Company. It had been fixed an hour earlier this year. The shareholders would have gained very full information by listening to the chairman's speech at the Direct Cable Company's meeting (hear, hear). They would have gone away with the greatest satisfaction at the excellent working condition of all their cables. The wonderful feat of the past year, the picking up of a cable 13 years old from a depth of 2,000 fathoms, would establish submarine cable property as an investment, and they could look for a demand for their cables perhaps three times as large as they had previously done (hear, hear).

Mr. Brown repeated that the deferred shareholders should have some claim on their consideration. He agreed that a reserve fund was essential, but they had now a large one, and he would move an amendment that they should have ½ per cent. out of the reserve fund.

Mr. Potts said that if he was not mistaken the Articles of Association provided that before the deferred shareholders received one sixpence the ordinary shareholders must receive 6 per cent. (hear, hear). (The Chairman: That is so.) Hence the deferred shareholders could not receive anything at all.

Mr. Brown: Then, in that case, I withdraw my amendment.

Mr. W. Griffiths said they must all sympathise with Viscount Monck on account of the reason of his present absence (hear, hear). He would quite endorse the view which had been expressed, that their meeting should not be allowed to clash with those of similarly interested companies. He cordially agreed with the arrangements lately made with Mr. Jay-Gould, only he thought it would be better to have entered into an agreement before the war rather than after the war (hear, hear). The war had cost them £280,000, and that sum might surely have been saved, and so they could have increased their dividends, given something to the deferred shareholders, and made the company much more secure. Their past policy had been too

bellicose, and he was glad a more peaceful prospect was opening. Mr. Pender had told them at the Direct Cable meeting that the Western Union had monopolised the whole of the land traffic, and consequently a feeling of independence had been roused against them, and, though they were in a wonderfully efficient state, a reaction had taken place. This would tend in their favour. He hoped they would abandon a warlike policy, and not use their large reserves to put more cables under water, for they had already sufficient to do all their work. They would then become a really good, substantial investment, and all their shareholders would be benefited alike.

Sir John Swinburne said some explanation was needed of the fact that under the head sundry creditors, £80,000 was due to the repairing company, and that no account was given of the other £40,000 necessary to make up the large sum put down. He thought the accounts very meagre, and they ought to have more detail.

The Chairman said that one item alone was £19,027 owed to the Western Union to balance account, and also £2,402 to the Eastern Telegraph, and £2,678 traffic balances.

Sir John Swinburne would suggest that such items should be laid before the shareholders.

The Chairman said that to any one calling at their offices they would be happy to supply particulars of these matters, but a detailed account would render their report too voluminous. They had no intention of increasing the number of their cables, as appeared to be hinted by Mr. Griffiths, but they had got to keep them in repair. The two cables of '65 and '66 had failed within ten years, another had gone to 13 years of age; of their others they had one of eight and the other of nine years, so they must be ready for emergencies. As to the time of meeting, their hour had been fixed in ignorance of the Direct Cable Company, but that would be avoided in future (hear, hear).

Mr. Newton asked whether the '65 cable was not of a different type of cable to those made now?

The Chairman said that their present cables were very much the same, only perhaps of improved make. Mr. Potts had been quite right in his contention as to the position of the deferred shareholders. They had given up their birthright to the preferred, and therefore received nothing. When the company paid only 3 per cent. over the whole of their capital, the deferred chose to pay their share to the preferred stockholders (laughter).

The report and accounts were then adopted unanimously.

On the motion of the Chairman, seconded by Sir Daniel Gooch, the Marquis of Tweeddale, who retired by rotation, was re-elected a director of the company.

Also on the motion of the Chairman, seconded by Sir Daniel Gooch, C. W. Field, Esq., was re-elected to the board.

On the motion of Mr. Seeley, Messrs. Dean and Glass were appointed auditors for the coming year at a remuneration of £100 per annum.

A vote of thanks to the Chairman was carried by acclamation on the proposal of Mr. Griffiths, and the proceedings terminated.

The India Rubber, Gutta Percha, and Telegraph Works Company (Limited).

THE 19th ordinary general meeting of this company was held at the City Terminus Hotel on Tuesday, "for the purpose of receiving the directors' report and the company's accounts for the past year, for the declaration of a dividend and a bonus, for the election of directors and auditors, and for transacting other business of the company."

Mr. George Henderson, the Chairman of the company, presided.

The Secretary, Mr. W. J. Tyler, having read the notice convening the meeting, and the report and accounts, which we have already published, taken as read,

The Chairman said: We are very glad to meet you with so good a report, and to put before you accounts showing such an excellent result of the year's business, enabling us to distribute a handsome dividend as well as to strengthen the company's financial position by so material an increase to our reserve. As our business increases so also must the reserve in order to supply the requisite working capital. How to place our new buildings and machinery within the limited space at our disposal has been a matter of considerable difficulty and anxiety to our manager, Mr. Gray, but this he has successfully overcome. As regards our factory at Persan-Beaumont we have been obliged to acquire additional land to connect our works with the railway and give room for the necessary extensions. Our chief cable expedition, that of laying the Central and South American cables, was carried out under the management of Mr. R. K. Gray, and both he and his staff deserve the thanks of the shareholders. The company's cable ships are all in first-rate condition. The *Dacia* and *International* are now under charter, and the *Silvertown* is on her way home with a freight which will go towards the coal bill and other ordinary expenses. We hope that the proposal to do something for our workpeople will meet with your approval. Mr. Gray will give you some information as to how we intend to proceed in this matter, but I may just mention that in the interest of employer and employé, we think that those of our people who come to their work from a distance should have a comfortable place in which to take their meals, and that by means of lectures and classes they should have opportunities of self-improvement and training to fit them for doing their work efficiently and intelligently, and that natural enjoyment and recreation should be provided for their leisure hours. I may mention that it is only proposed that the first cost of erection should be borne by the company—the cost of maintenance and all beside by the workers themselves. I do not know that I need detain you longer, but we shall be happy to hear any shareholder who may desire to address the meeting. Meanwhile I beg to move "That the report and accounts now presented be received and adopted, and that a dividend of £1 per share, and a bonus of £1 per share, free of income tax, payable on and after the 14th instant, be now declared" (applause).

Mr. S. W. Silver: I have very great pleasure in seconding the motion.

Mr. Dixey: I am not a very large shareholder in this company, but, having been connected with it for many years, I may be permitted perhaps to make a few remarks to express the intense pleasure and satisfaction I felt in reading the report which has been submitted to this meeting. It was pleasant, sir, to find that every department in connection with the company had been fully employed during the past year; that the debentures and shares in other companies had been greatly reduced; that certain securities had been disposed of at a considerable profit; that £100,000 had been added to the reserve fund, and that after the payment of 25 per cent. to the shareholders, there yet remained a balance of £36,311 7s. 3d. to be carried forward to 1883, a sum almost double that carried forward in the previous year. I venture to say that a report such as this has seldom been submitted to any body of shareholders, and we may well congratulate the directors and each other to-day upon the prosperity which this company has attained. But, sir, there is a paragraph in this report to which I have not yet alluded, which strikes me as constituting its grandest feature, and that is the suggestion made by the directors to appropriate the sum of £6,000 towards the building of a hall and dining-rooms, and providing accommodation for the comfort, instruction, and amusement of the workpeople at Silvertown. Now, sir, this is a proposal which appeals at once to our highest and best instincts, and one which I trust will commend itself to the great body of shareholders, for it cannot be denied that the workpeople of Silvertown have contributed to the success, in some degree at least, upon which we congratulate ourselves to-day (hear, hear). We are indebted to the directors for the sagacity and the wisdom with which they have conducted the affairs of the company; we are indebted to Mr. Gray, the manager, for his business tact, for his indomitable will and energy; we are indebted to the secretary and other officials for the interest they have taken in the company, but behind the directors, behind the manager himself, behind these most prominent officials, there are latent forces which we are too apt, perhaps, to overlook and ignore, but which are nevertheless absolutely essential to the success of a company such as ours. These latent forces are the workpeople at Silvertown, and it is impossible to say how much we are indebted to them for their sobriety, for their industry, and for their skill (hear, hear). Now, sir, I must say that I heartily rejoice in the suggestion of the directors. I consider that it is a noble one, and one which I trust will be followed by other companies. If employers generally would only show the same spirit of considerateness and generosity that is now about to be shown by this company, the vexed question of capital, which is now agitating the community, would soon reach a pacific and permanent settlement, and there would be an indissoluble bond of union established between employers and their employés. It so happens that in my lifetime I have had a great deal to do with working men, and I know that they are not lacking in gratitude and appreciation. Some years ago it fell to my lot very frequently to visit Silvertown, and I always found the people there ready to receive instruction, and to welcome especially that highest form of instruction which we call religious instruction ("Time"). I see, sir, that this suggestion of the directors speaks of the comfort and instruction and amusement of the people at Silvertown. I know that amusement comes last, but I may be excused for saying that I venture to hope that it is not the ultimatum—the final end of the directors. Let the workpeople have amusement by all means; let them have music, let them have concerts, and let them have chess ("Time")—I won't be a minute more—let them have everything that may minister to their amusement; but with all this let us see that there is combined a higher form of instruction that will augment their intelligence, and that will influence them in their moral principles. I must apologise for taking up your time, but I wish heartily to commend this suggestion to the great body of the shareholders, and I trust ere long it will be developed into a scheme, which, in coming years, will redound to the credit and honour of this company (applause).

A Shareholder: I presume the entire reserve fund is used in the company's works?

The Chairman: Yes!

The Shareholder: To what amount do you intend to raise the reserve?

The Chairman: Really we cannot answer that question. As our business increases, so must our reserve fund.

A Shareholder: Is it invested in any particular way?

The Chairman: No!

A Shareholder: How would it be available in cases of losses on contracts?

The Chairman: All our working capital is available for losses, but I hope we won't require it for such purposes.

Mr. Hancock said that in their previous accounts the profit on the sale of investments was given, but that in that year's accounts no such sum was stated. As the profits of the company had largely increased during the year, he thought they might naturally conclude that there had been considerable profit on the sale of investments, and perhaps the Chairman would be able to give them a little information on the subject.

The Chairman: It is not usual for us to disclose where our profits come from, and we being a trading company, I must object distinctly to state the sources.

Mr. Hancock thought that as profits of the kind he mentioned had nothing to do with manufacturing, the chairman's reason for not giving the information he asked was scarcely sufficient. The amount shown as annual profit would be likely to vary immensely if it were made up of the two items—the profit on manufacturing and the profit on the sale of investments. However, he need scarcely say how much pleasure it gave him to congratulate the company on

the present position of affairs. The profits now amounted to as closely as possible the sum which he once stated they might be able to secure if they got a capital of from £250,000 to £500,000. They might reasonably conclude, he thought, that the present satisfactory state of affairs was likely to continue and also to improve. He was exceedingly pleased with that portion of the report suggesting the expenditure of £6,000 for the comfort, instruction, and amusement of the workpeople at Silvertown.

Mr. Sinclair had not intended to say anything, but the remarks which had been made called for a few observations. The chairman had very properly, he thought, declined to give the particulars as to where the profit had been derived. They had had not only a good dividend, but a bonus, and they might, therefore, without going very carefully into the matter consider that the profits were represented by the dividend, the amount carried to the reserve fund, and the balance to 1883, and that the bonus was what had been derived from the extraneous profits. He thought it was only advisable that that should be borne in mind by shareholders, because when a dividend of 25 per cent. was paid they were very apt to think they would and ought to get the same again. They might not, for some time at any rate, see such a dividend again—he hoped they would—but anyhow they ought to consider themselves very well paid if they got the dividend, apart from the bonus, in future years. He had pleasure in joining in the congratulations offered to the chairman and other members of the board of directors on the report they had presented to them, and in congratulating them most sincerely upon their having brought the company through its past difficulties.

Mr. Johnston said notwithstanding the handsome dividend and bonus he thought it right to draw the attention of the meeting to the fact that the actual profits of the year amounted to over 60 per cent. They received 25 per cent., thus leaving a large margin for any depreciation in the profits of another year, so that he thought it was not advisable to predict that they would not have 25 per cent. another year. He thought they would (hear, hear).

The motion was then put and unanimously carried.

The Chairman: The second motion I have to bring before you is, "That Mr. Silver and Mr. Bannatyne be, and they are hereby, re-elected directors of the company."

Mr. Jones: It is in my province to second that proposition for various reasons which it would be out of place for me to-day to enumerate, and I do so with pleasure. The board know me better than the proprietors. I had the honour of being a director of the company many years ago, when it was struggling for the mastery of its difficulties, and I am proud to-day it has mastered them, and that its progress has been such as to surpass our expectations.

This motion was likewise unanimously carried.

Mr. Silver: It remains for me to acknowledge and thank you for this evidence of your confidence in us, and to express a hope—and a very strong one—that we shall continue to merit that confidence.

Mr. Bannatyne also returned thanks.

Mr. J. Weise and Mr. Abraham Scott were re-elected auditors for the current year, with a fee of 30 guineas each.

Mr. Gray: I have now to move, "That the directors be, and are, hereby authorised to expend out of the funds of the company a sum of about £6,000 on the erection of a hall and dining-rooms on the company's property." Before I say a word in reference to this resolution, let me congratulate the shareholders on the position in which the company now is. The only reason I at all refer to it is that I want to warn the shareholders that, although we will do everything we possibly can for the success of the company in the future, the last year was an exceptional year. Do not, I beg of you, let it enter your minds that it is to be easily repeated. I do not say it will not be repeated; I hope it will, but I do not wish any shareholders to have any anticipation that it is anything like what will usually be the case. I do not wish to depreciate the property, but I do not wish to disappoint the shareholders. I have been very ably seconded by all the staff, and of any little praise that may be given to us, they have to get their full share. They work well for the interests of the company, and I am well supported. In reference to the workpeople, I endorse the remark of a shareholder that they have aided us in earning the money we have earned. Some of your shareholders may not know that about twenty years ago the little works built by Mr. Silver down at Silvertown were placed in a marsh, with nothing surrounding them—no dwelling-houses near, nothing but a deep damp marsh. We have gone on building works, and houses have been built in the neighbourhood, but, with all the care we have been able to bestow on it, it is not a very desirable place for anybody to live in, and we have had difficulty in getting the workpeople to reside close to the works. It has been our desire to make them as far as possible comfortable, and we have managed now to erect works with proper machinery and to make the workshops well ventilated and comfortable; and I think the 1,500 workpeople we have now in our employment are about as comfortably supplied with workshops as anybody else; and, concerning the appliances at the works, I do not think I am wrong in saying they are second to none in London or elsewhere. It has been a work of labour, but it has been done, and I think done well. We ask you to vote this sum of money, and submit the motion with a great deal of pleasure. We think it is needed. Some of the workpeople come long distances and have not got a place in which to take their food, and we want to give them an opportunity of taking it comfortably. We propose building one dining-room for the women and another for the men; and in addition to these we propose to build four class rooms and two libraries—a library where newspapers and books will be handed out by the librarian, and another where a man can read his book and smoke his pipe and make himself comfortable. Some of you gentlemen may object to smoke—I don't (laughter). We also propose building a hall that will accommodate 600 or 700 people, in which lectures and concerts can be held and enjoyed in comfort. Some little time ago we started the Silvertown Institute, where chemistry, mechanics, and natural philosophy in nearly all its branches are taught, and I must say that the people of Silvertown have been very attentive and that the teaching has been very successful. Some of the students have been examined at Kensington and also at Guildhall, and I think they took five gold medals and seven or eight silver ones, besides some certificates, so that the institution at Silvertown is worked well. When this hall is erected the workpeople will then have a place both for instruction and amusement quite handy to the work. I hope you will agree to this; it is much needed and the workpeople deserve it (applause).

Mr. Hanson: As one of the fortunate shareholders of this company, it gives me pleasure to second the resolution. The subject commends itself. If we want our work well done, I am sure we cannot do better in our own interest than to promote the interest of our workpeople.

Mr. Jones supported the resolution, and it was unanimously passed.

A vote of thanks to the chairman and directors concluded the meeting.

The Great Western Electric Light and Power Company (Limited).—An extraordinary general meeting of the members of this company was held at the Cannon Street Hotel on Tuesday "to receive a report from the directors as to the steps they have taken in connection with the litigation instituted by several shareholders against the company, and to pass any resolution which the meeting may consider desirable in relation thereto." Reporters were excluded.

The Telegraph Construction and Maintenance Company (Limited).—The directors of this company propose (subject to the audit of the accounts) paying a dividend of 15 per cent. (£1 16s. per share) in addition to the *ad interim* dividend of 5 per cent. already paid, making 20 per cent. for the year 1882.

The British Insulite Company (Limited).—This company is about to appoint a manager at a salary of £400 per annum.

The Oriental Telephone Company (Limited).—The directors of this company have declared an interim dividend on the ordinary shares of 2½ per cent. (free of income-tax) on account of the profits for the financial year ending the 31st December, 1882.

The Garrett-Bennett Cable.—The *Times* in its money market and City intelligence of Tuesday announced that the securities of the Anglo-American Telegraph Company were flat on the report that the scheme for a "Garrett-Bennett" cable is not yet abandoned. A *Times* telegram, dated Philadelphia, February 12th, says:—President Garrett, of the Baltimore and Ohio Railway, at an interview, reported in the Baltimore *Sun*, to-day, stated that the statement made by Mr. Pender at the meeting of the Direct United States Cable Company, in London, that the project of laying the Garrett-Bennett Cable had been abandoned was unauthorised, and that the cable would be laid as soon as practicable.

Transmission of Power to Long Distances.

THE *Times* Paris correspondent writes to that journal of the 15th inst. as follows:—

PARIS, Wednesday, Feb. 14.

"Experiments in the transmission of force to considerable distances by electricity are going on at the Northern Railway workshops, under the direction of a group of scientists and mechanicians, who propose to work the discoveries of the eminent electrician, M. Marcel Deprez. The experiments are attracting all the notabilities in France. The Deprez theory is that the waste of force in transmission is invariable, irrespective of distance. With his dynamo-electric machines 50 per cent. of the force reaches the terminus, whether one mile or five hundred miles distant. This is effected by machines giving the *maximum* of tension with the *minimum* of quantity; and in these machines the ordinary electric wire is being employed, though hitherto it has been objected that for any considerable distance thick and costly copper wires would be essential. In one of the experiments the force was transported 35 kilomètres, and having been of 10 horse-power at the starting point, it was still 5 horse-power at the point of arrival. . . . .

"It must be hoped that objectors are mistaken. Such a wonderful change in the order of things one would fain live to see, and be proud of having believed in beforehand. . . . . It would be a grand thing to see whole towns enjoying the benefit of cheap electric light, and to see huge chimney stacks disappear, together with the smoke that blackens the air, faces, and lungs of the inhabitants of our industrial centres."

The *Times* has not at any period been remarkable for the accuracy of its scientific articles—at any rate, as far as electrical subjects are concerned; and it is a matter of some concern to those having the future progress of electrical science at heart to observe how the public may be misled by perusing the columns of the "leading daily." We have never denied that power may be electrically transmitted, and only make objection to the methods employed in some quarters for carrying out the experiments, whereby leakage on a line of telegraph wire used for the electrical transmission of power *actually appears to indicate* a greater mechanical return than is really the case. In other words, a *given* horse-power at the transmitting station apparently shows a return in the receiver, *say* of 50 per cent., through a wire, for example, 20 kilomètres long, and having a resistance of 160 ohms, whereas the leakage on the line reduces this resistance, and therefore its equivalent length in actual practice. It is therefore incorrect to say that the return was obtained through an *actual* length of 20 kilomètres, or through a *resistance* of 160 ohms, when using the machines as connected up in M. Deprez's experiments.